MACHINE DESIGN

PARTS • MATERIALS • METHODS • FINISHES

THE PROFESSIONAL JOURNAL OF CHIEF ENGINEERS AND DESIGNERS

Volume 9 MAY 1937 Number 5

EDITORIAL STAFF

Editor
L. E. JERMY

Associate Editors
Guy Hubbard
Fred Kelly
F. H. Burgess

New York . . . . . B. K. Price
Chicago . . . . . W. G. Gude
Pittsburgh . . . . . D. R. James
Detroit . . . . . A. H. Allen
Washington . . . . . L. M. Lamm
London . . . . . Vincent Delport

BUSINESS STAFF

New York
J. F. Ahrens, *Eastern Mgr.*
Russell H. Smith

Chicago
H. H. Dreyer, *Western Mgr.*

Cleveland
H. B. Veith, *Central-Western Mgr.*

Published Monthly by
THE PENTON PUBLISHING CO.
Penton Building, Cleveland, Ohio

John A. Penton . *Chairman of Board*
E. L. Shaner . *President and Treasurer*
J. R. Dawley . . . . *Vice President*
G. O. Hays . . . . *Vice President*
F. G. Steinebach . . . *Secretary*

BRANCH OFFICES

New York . . . . 220 Broadway
Chicago . . . Peoples Gas Building
Pittsburgh . 1650 Koppers Building
Detroit . . 1010 Stephenson Building
Washington . National Press Building
London . . . . . Caxton House, Westminster, S. W. 1

CONTENTS

Page

Heat Treatment as It Affects the Designer—Part III . . . 29
By Lewis F. Herron

Scanning the Field for Ideas 33

Optical Devices Enter Machine Design Field 36
By Guy Hubbard

Engineering Department Should Specify Correct Lubricants . 40
By Fred B. Jacobs

Rubber Affords Protection for Machine Parts 43
By Fred Kelly

Electricity Scores Again—Light Acts as Bullet 45
By L. E. Jermy

Automatic Transmissions Prove Foolproof Unit 47
By Austin Wolf

Designers Take Part in Forum on Electrification 49

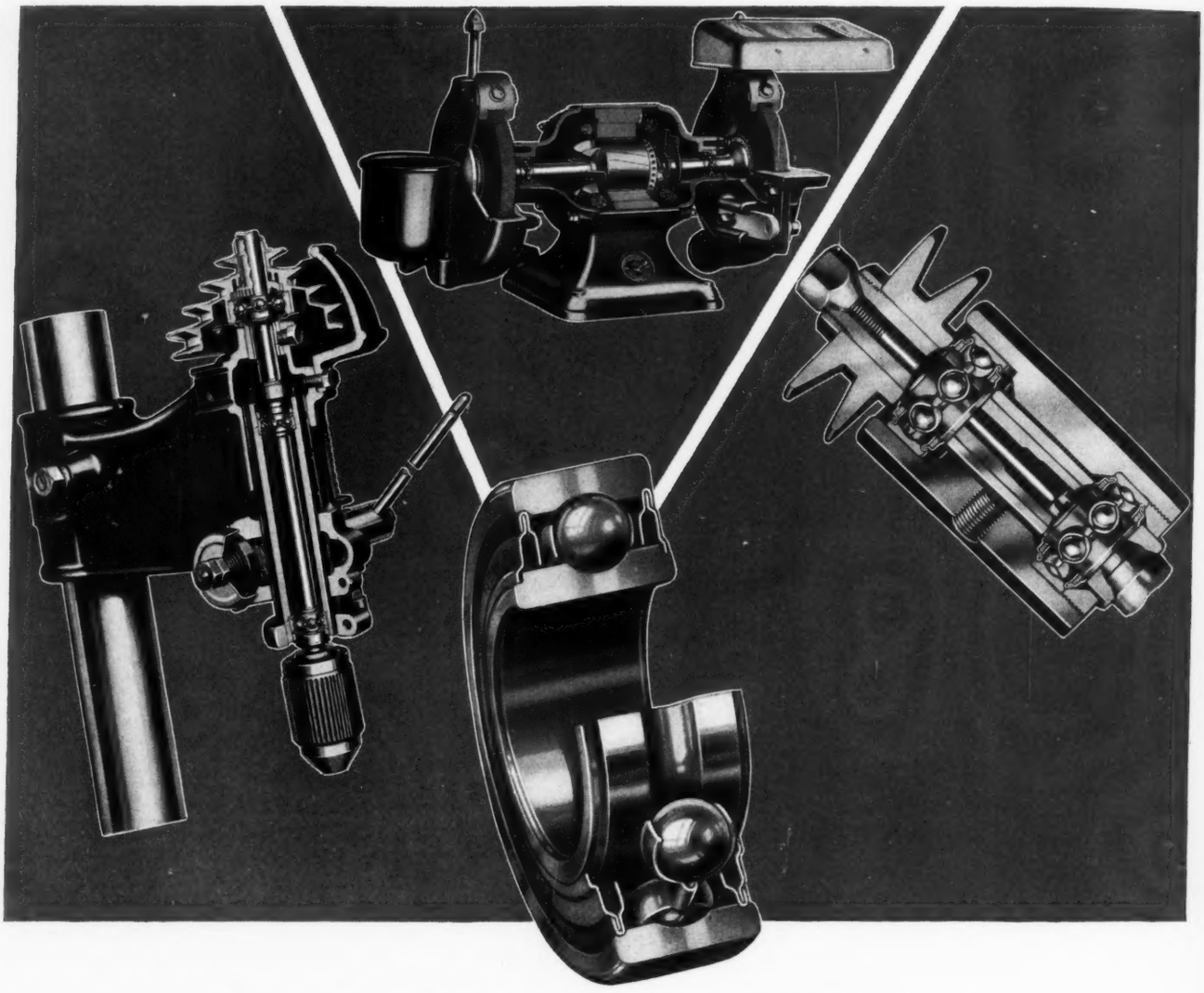
Design Features in New Machines 50

New Machines Indicate Design Trends 52

Workers "Real" Wages Are Increased Through Faster Production by Machines (Editorial) 53

Professional Viewpoints 54
Men of Machines 56
Noteworthy Patents 60
New Materials and Parts 68
Calendar of Meetings 84
Manufacturers Publications 86
Business Announcements 92
Topics 26

MACHINE DESIGN is published on the tenth of each month. Subscription rates: United States and possessions, Canada, Cuba and Mexico, two years $5; one year $3. Single copies 35 cents. Great Britain and other European countries, one year $5. Copyright, 1937, by The Penton Publishing Co. Acceptance under act of June 5, 1934, authorized July 20, 1934.



Sealed Against Wear!

DIRT is abrasive—it causes *wear*—it is always trying to get into machines and bearings—is always working to shorten their life. Dirt is Bearing Enemy No. 1. But N-D-Seals keep it *out*—keep lubricant clean and *in the bearings* where it belongs. The Delta Manufacturing Company knows from years of experience that N-D-Seal bearings keep machines running longer, more efficiently, and with less cost for upkeep. By equipping their tools with N-D-Seals, they give the machine user extra value—greater serviceability.

Because of their proved economies, millions of N-D-Seal bearings are now in service throughout industry. Though the originator and principal producer of self-sealed bearings, New Departure overlooks no opportunity to advance N-D-Seals to yet higher standards of efficiency and economy. New Departure, Division General Motors Corporation, Bristol, Connecticut.

NEW DEPARTURE

PIONEER OF SELF-SEALED BEARINGS . . .

N-D-Seals

2521

SWEAR IN THIS WITNESS TO YOUR SALES ARGUMENT

BUILD A COUNTING DEVICE INTO YOUR PRODUCT

When a prospect puts you on the stand with: "What can your product do for me?"—can you give him *qualified testimony?* Yes, you can tell him *exactly*, in terms of actual operating figures—if your product is equipped with a built-in Veeder-Root Counting Device.

For products so equipped can produce positive proof of their own performance. Proof of what can be done, in terms of what has been done for others, is being supplied daily by Veeder-Root Counting Devices on such products as business machines, elevators, tractors, trucks, typewriters, machine tools, guns, cameras. Built-in Veeder-Root Counting Devices give accurate, permanent records from the outset of a product's service—records of operations, starts, stops, pieces, trips, mileages, volumes, speeds, lengths.

Find out, *now*, whether you can increase the salability of *your* product with a built-in Veeder-Root Counting Device. Veeder-Root engineers will be glad to work with you in strictest confidence. Write.

VEEDER-ROOT

Counters for Every Purpose

VEEDER-ROOT, INCORPORATED
HARTFORD, CONNECTICUT, U. S. A.

OFFICES IN BOSTON, CHICAGO, CINCINNATI, CLEVELAND, DETROIT, GREENVILLE, S. C., LOS ANGELES, NEW YORK, PHILADELPHIA, PITTSBURGH, ST. LOUIS, SAN FRANCISCO, MONTREAL, CANADA, BUENOS AIRES, MEXICO CITY, LONDON, PARIS, TOKIO, SHANGHAI, MELBOURNE

TOPICS

MACHINES made in the U.S.S.R. have come under a critical eye in this country. Our engineers have been inclined to speak deprecatingly of the Russians' efforts in the field of machine design. We even refer to their airplanes and autos as outmoded, inefficient machines comparable to models made in this country ten years ago. It would seem, however, that we will be forced to make a complete "about face." Events in the Spanish civil war indicate that Russian airplanes, pitted against the best military planes of Germany and Italy have trounced them soundly. Not only are the planes themselves faster and more maneuverable, but guns mounted on them have outshot those of the enemy. Inasmuch as German and Italian airplanes are superior to our own fighting ships in some respects it causes us to wonder just how "out moded" are these machines made in the U.S.S.R. today. As we have taught the Russians much of their engineering, we better determine who is the smartest—the teacher or the pupil.

♦ ♦ ♦

Though rear-engined vehicles have numerous advantages over the conventional drive type, we learn that the distance between the driver's seat and the power plant in busses, for instance, is causing one unforseen difficulty. Shifting gears, of course, is a process which requires exact timing of engine speed and car speed to be accomplished without jerks or clashing of gears. Drivers are accustomed to listen to the engine to determine the correct speed, but with the rear-engine type they are not able to hear it. To enable the driver to hear his engine and thus be signaled of the correct moment for changing gears, a miniature loud speaking system has been installed in several busses. A microphone is mounted close to the engine and the loud speaker is placed near the driver. No matter how much noise is in the bus, the driver hears his engine clearly and can change gears with perfect synchronization.

♦ ♦ ♦

Building-in radios in the most unlikely and unusual places seems to be a definite vogue lately. In hotel rooms one finds them snugly tucked away in a writing desk or telephone stand; at home they may be found anywhere—from a smoking cabinet to milady's dressing table. One never knows whether he will hear the purr of an engine or a blast from a radio when he turns a knob in a strange auto. One radio manufacturer has gone a step farther. He has combined a refrigerator and radio into one. He claims that a housewife spends sixty per cent of her time in the kitchen and with this combination may enjoy her favorite programs while engaged in cooking chores. We are definitely in favor of keeping the refrigerator unsullied from radio activities and we are not so sure that we want to encourage housewives to spend so much time in the kitchen anyway. We are afraid our gas bills will be higher and that there will be too much experimenting with the food.

♦ ♦ ♦

Milwaukee police are well equipped for any riots that may occur in that fair city. A new machine intended to be driven into a mob and used as a base of operations has been put in use there. The car is fully armored with thin steel and bullet proof glass; convenient gun ports are provided on all four sides and novel wheel pants can be let down to protect the tires from gunfire. Under the outside skin of thin steel are layers of felt, hardwood and finally a ¼-inch thickness of aluminum alloy. A heavy steel shutter protects the radiator from bullets and the engine is housed within the bus to prevent tampering by belligerents.

♦ ♦ ♦

Engineers of the coming generation will be more interested in developing transportation and construction machinery than their predecessors if a trend observed at the American Toy Fair in New York City last month is correct. Mechanical toys are replacing wooden soldiers and other warlike toys frequently criticised by pacifists as making children war conscious. Toys most prevalent at the fair were those which reproduce construction, transportation and building machinery of modern life. Centrifugal pumps, lifting pumps and hydraulic rams which can be used to imitate even the salvage of sunken ships were on display for the first time.

MACHINE DESIGN

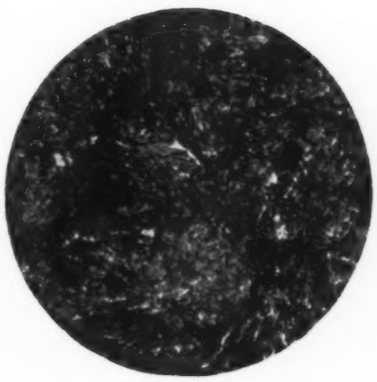


Fig. 1 and 2—Left and Right —Comparison of effect on microstructure and hardness when variation in diameter of section is encountered. Section shown at left is from ½-inch diameter piece; Brinell number is 285. Section at right is 1½ inches; Brinell No. 235

Heat Treatment as it Affects the Designer – Part III

Lewis F. Herron
Metallurgist, James H. Herron Co.

IN DAYS not long past a designer might have said to the blacksmith, "Jake, hammer out for me a drift from that 'Super Extra XXX' same as the last one and temper it in that barrel of Sheffield water from England, to a deep straw color." But Jake, being out of the "XXX," would have to use "Ne Plus Ultra ZXY," which he preferred to harden in oak-leaf water or possibly something even commoner.

Today the order will be specifically: "Part No. 13-416, steel 6150, treat X55-F (C50-56)," which conveys to the metallurgist precise information on the hardening furnace, quenching medium, medium for drawing, and hardness required. This concise modern method of specifying what is desired insures a superior and uniform product.

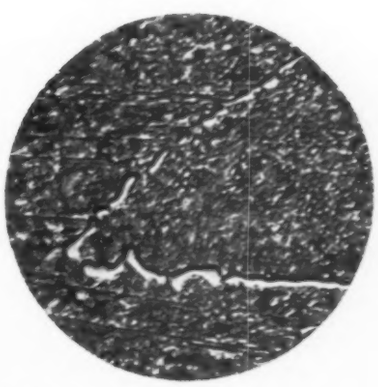


Fig. 3—Caution is essential in carburizing to prevent a cementite network in case as shown. Cementite produces a brittle case, making the part prone to spall and crack in service

Practically every composition of steel used for machine parts is now referred to by number, either SAE or some modification thereof. Even the alloy tool steels are being classified by numerals indicating the nominal amounts of alloy present. This is certainty a forward

Fig. 4—Austenite retained at surface of carburized gear. Light areas are austenite, the darker needles martensite

step, and the Society of Automotive Engineers is to be commended for its increased coverage of the field of composition. This does not mean we are advocating that the designer should increase the number of types of steel entering his product, quite the opposite, in fact. The many types now available should enable him to select a grade which will replace several other compositions, thereby effecting savings through simplification; reduction of material costs and of inventory also may be effected.

Speaking of SAE specifications, it is in order to suggest that the designer read the section on metals carefully. He should not try to obtain all his information on temperatures and physicals from the charts without knowing just what they mean. The 1937 SAE Handbook states, "They (the charts) are intended only as a guide to proper heat treatment of the steels, and to indicate conservative physical properties that may be expected of standard test specimens .505 x 2 inches machined from rolled bars up to 1½ inches diameter or square."

Older Handbooks Were Explicit

The older handbooks were more explicit and stated, "For the sake of simplicity it has seemed advisable to use only average minimum figures for tensile strength, yield point, reduction of area and elongation, based on the following considerations, heat treatment being constant:

"(1) The lowest yield points and tensile strengths are produced with steels at the bottom of a given range in carbon.

"(2) The lowest reductions in area and elongations are produced with steels at the top of a given range in carbon.

"(3) The figures for hardness are conventional averages for the whole range of compositions within any given specification."

It has been our experience that the hardness, tensile strength and yield point as shown for a given drawing temperature are generally exceeded considerably in actual practice.

Another suggestion concerning the use of handbook charts showing physical properties, or at least hardness resulting from various drawing temperatures following a specified quench, is that the designer avoid specifying both drawing temperature and hardness of heat treated parts other than carburized work. Differences in the manner in which a piece responds to treatment, due to section, permissible variation in composition, and inherent "hardenability" of steel from a certain heat, may show the chart to be far from right in a specific case.

The metallurgist or heat treater will work to the hardness limits in any event, since he is primarily interested in getting his work past inspection. Inclusion of a drawing temperature which is far from correct will serve only to lower his respect for the designer. *Figs.* 1 and 2 illustrate the effect of section on the hardness and microstructure of the same part when considerable variation in diameter is encountered. The steel was SAE 1035, quenched in oil and drawn at 800 degrees Fahr.

Fine Grained Steels Resist Grain Growth

It will be of interest to some designers to know just what the developments in grain size control mean so far as the heat treater is concerned. Fine grained carburizing steels resist grain growth to a greater degree than do coarse grained steels. Therefore the fine grained steels will stand higher carburizing temperatures, which speed up penetration. Also in many cases, especially where a moderate nickel content is present, these steels allow use of a single quench to refine both case and core, thus producing a harder core than is attained through other refining procedures.

A word of caution, however. If higher carburizing temperatures are employed, the temperature should be dropped at the end of the run to permit of diffusion. Otherwise the case may be too high in carbon, and will have a cementite (iron-carbide) network such as is shown in *Fig.* 3. This condition produces a brittle case, prone to spall and crack in service.

In the design of carburized parts involving relatively

Fig. 5—Fracture of locomotive axle which failed at the wheel-fit. Improper press fits are dangerous

large bores in proportion to thickness of case desired, close co-operation with the metallurgist in developing a method of handling to avoid distortion is important. A distorted piece is bound to have a case of varying thickness after finish-grinding. Precautionary measures include normalizing the piece to remove stresses; cooling in the box; quenching to refine the case only; quenching in fixtures; and careful selection of the type of steel. When we mention quenching in fixtures, we have in mind those fixtures which actually restrain the piece from distorting, as well as those which cause the piece to enter the quenching medium in the most favorable position.

With higher alloyed carburizing steels, the designer should be careful about the specification of salt baths as reheating mediums. For instance, with the addition of nitrogen to the carbon in the case, austenite may be retained—particularly on the surface of the case. While the austenite may transform to martensite in use, the case will not show the "file-hardness" usually desired. On the other hand, a martensitic cyanide skin on hardened gears which are not to be ground has been found most desirable, even the most minute decarburization being undesirable. *Fig.* 4 reveals the microstructure of case of a carburized gear with austenite retained at the surface. Light areas are austenite, the darker needles martensite.

We believe that most difficulties involving case failure are due either to insufficient case depths or to a soft core. Here again we suggest that case depth rather than carburizing time be specified. It should of course be clearly indicated whether the case depth specified refers to the "effective case," (hypereutectoid zone) or to "total case." The reason for specifying depth is because many different methods and variables are encountered in carburizing. With these the metallurgist is more familiar than the designer, hence he should be given the task of producing the desired result. It will readily be understood that in the event of failure of a part in service due to a thin case, the responsibility then falls upon the metallurgist, where it properly belongs.

Soft Core Often Not Necessary

Today many machine parts are being produced successfully from the higher carbon steels which were formerly considered suitable only if carburized. This change in technique is due not only to improved steels, but also to the fact that experiments and experience have proved that for many applications the tough backing of a soft core is unnecessary. Furthermore it has been found that the depth of hardening of higher carbon steel is controlled by McQuaid-Ehn grain size. The coarser grained steels are deep hardening and those of finer grain the reverse, thereby permitting a degree of control formerly impossible.

New methods of heat treating are constantly being devised, especially for localized hardening. These include use of electricity not only to heat by resistance but by induction as well; use of photoelectric cells to determine rapidly changing temperatures; and improved methods of flame hardening, especially for gears. Controlled atmospheres are eliminating the necessity of finish machining or grinding, and are even controlling to some extent at least, the expansion which occurs on hardening.

The matter of furnace atmosphere is of considerable importance if parts subject to fatigue stresses are used with the "skin on." It is obvious that with maximum fiber stress occurring at the surface, the condition of this surface is a vital factor. The fatigue limit of decarburized steel is low, and once a fatigue crack starts it creates a severe notch condition which favors progression of the crack through sound material. Fatigue strength of flat springs carefully treated to avoid decarburization is nearly twice that of springs which have moderately decarburized surfaces.

The medium or atmosphere in which a stressed part operates in service has much to do with its fatigue resistance. For instance, under corrosive conditions the fatigue strength of a ferrous part may soon be reduced by half. It has been shown that cyclic stress accelerates corrosion, and also that increase in static strength through heat treatment has little effect on corrosion-fatigue limits, or more properly stress corrosion. The use of corrosion resistant steels or coatings is indicated under these conditions.

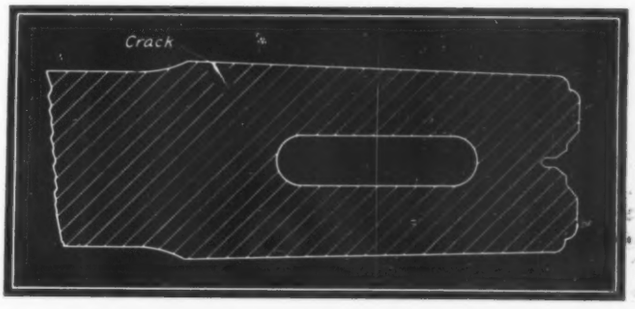


Fig. 6—Another "fit failure". A slight relief at the point where the fatigue crack starts will correct this condition

Recent investigations have proved that improper press fits are a serious menace to the life of a shaft, in some cases reducing the fatigue limit by half. *Fig.* 5 shows the fracture of a properly treated locomotive axle which failed at the wheel-fit. Here it is obvious that the failure had two distinct origins. Another example of a "fit failure" is that illustrated by the drawing of the end of a piston rod, *Fig.* 6. The slot enables a key to draw the piston and rod together in a tight fit. Fatigue cracks started at the exact point where the rod entered the piston, in spite of a much smaller section immediately adjacent. A slight relief at this point corrects the condition.

Fig. 7 depicts a torsional failure of a poorly heat-

treated propellor shaft which failed under a moderate shock. Izod impact tests showed from five to seven foot-pounds only, when at least thirty could be expected from a properly treated forging.

Heat treating of cast iron is being practiced to a constantly increasing extent, not only artificial "ageing" to prevent future distortion but quenching and annealing treatments as well. This is true especially of the new compositions which can be described as intermediates between iron and steel. These "super-irons" have a modulus of elasticity in the working range which is nearly equal to that of steel, while the old soft gray iron was about one-third as stiff.

Welded construction is increasing in favor. In connection with it the designer should either specify stress-relief at 1150—1200 degrees Fahr. or should consult with the metallurgist and experiment to find the best way of avoiding or balancing the welding stresses.

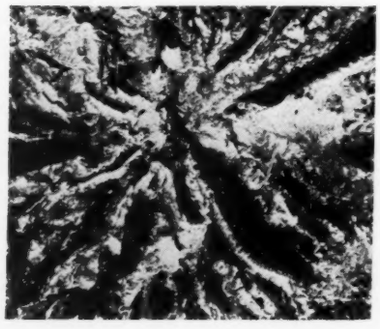


Fig. 7 — Torsional failure of a poorly heat - treated propeller shaft which failed under moderate shock

Localized treatment often offers possibilities in design of parts where toughness is desirable throughout the greater portion, with hardness required only in certain small areas. It oftentimes is practical to give double after-treatment to a case hardened part, one to develop hardness in the case, the other to develop toughness in the core. Then again it may be desirable to leave one end of a part—a thread for instance—soft. One expedient is to carburize the part before machining, the case being machined off the end before reheating and quenching. Then again it may be desirable to shrink on a ring of high carbon or alloy steel on a low carbon or even a cast iron body, durable ring gears often being applied to this manner.

Bearing Manufacturers Using Larger Chamfers

It is significant that manufacturers of ball and roller bearings today are providing much more generous chamfers at the edges which are likely to encounter filleted corners, as at the junction of webb and throw of a crank. This removes a difficulty which designers formerly encountered when attempting to use fillets in places where the ends of bearings were supposed to build up against shoulders.

The moment a pit is started by corrosion, it not only becomes a stress raiser, but the constant working of corrosive action in the minor crack can well be compared to a powerful wedge being driven down into the heart of the metal. Where corrosive conditions will be encountered, the use of corrosion-resisting metal or the application of protective coating is vitally necessary to insure a permanent factor of safety.

In negotiations between the engineering department and the heat treating staff, especially if the heat treating is "farmed out" it is extremely important that there shall be a common understanding of terms and requirements. The following are some thoughts along this line offered by the Lindberg Steel Treating Co.

Specific Instructions Are Essential

First and foremost designers should bear in mind that the steel treater is interested primarily in these three things; the kind of steel; the kind of heat treatment; and the application of the part. As to the first, avoid such general terms as *"Cold Rolled", "Hot Rolled"* and *"Machinery Steel"*. They refer to methods of manufacture rather than to analyses, and analysis is what the heat treater must have. Therefore, give him the SAE number, the brand name or the actual analysis. *"Heat Treating"* and *"Steel Treating"* also are general terms, and even *"Case Harden"* to one man means cyanide hardening, while to another it means carburize and harden. Neither is *"Pack Hard"* a definite instruction. To one it means a method of raising the carbon content of the surface of a part, to another it means a method for protecting parts against scaling or decarburizing during heat treatment. To avoid confusion, specify depth of case if a case is desired.

The simple specifications *"Hard"* or *"Tough"* likewise are inadequate. If the desirable Rockwell, Brinell, sclerescope or monotron index is not known, the next best thing is to tell the heat treater exactly what the part is for and what is expected of it in service.

When a customer says to a commercial heat treater, "This is a piece of *hot rolled* material," questions immediately will be raised as to whether he means low carbon steel—say .10 to .20; or high carbon steel such as .40; and also whether it contains other alloying materials. In one case a spindle was delivered for carburizing and hardening, with the statement that it was *Machine Steel.* The treatments were given on the assumption that it was SAE 1020 steel, but in the straightening operation it snapped like a piece of chalk. It was actually .50 steel!

No wise designer will ever misunderstand or resent the apparently insatiable curiosity of a metallurgist. Rather, he will take pains to tell him such things as what allowance has been made for grinding after heat treating or whether only a polishing operation is to follow. He will tell him what degree of straightness is required—particularly on parts which may be inclined to warp. To sum it up, the more the designer tells the metallurgist the better the result will be.

THE END

SCANNING THE FIELD FOR IDEAS

AIRCONDITIONING of a motor coach has been accomplished successfully by the White Motor Co., working with the Nash-Kelvinator organization. The vehicle in which the initial installation has been made, and which now is undergoing road tests in Texas, is of 33-passenger type and is streamlined.

The airconditioning system, said to be the first designed exclusively for motor coach service, comprises cooling coils, refrigerant compressor, blowers, and a constant-running 4-cylinder gasoline engine which gives five power strokes to each compressor stroke. As is shown in *Fig.* 1, these elements are combined into a compact unit which is housed in a compartment in the rear of the coach body.

Outside air is delivered to the airconditioning unit from the front of the body and after cooling is distributed throughout the coach through a patented system of ducts built into the luggage racks, which are directly above the seats the full length of the body. The cooled air is forced downward from these ducts onto mushroom-shaped horizontal reflectors so as to envelop the passengers indirectly, without subjecting them to drafts.

The windows are of course kept closed at all times, although they are designed for easy and speedy opening in case of emergency. The airconditioning system, which is automatically controlled, is designed to change the air in the coach every three minutes, and to effect proper cooling and conditioning of that amount of air under the most difficult conditions which will be encountered in long distance, high speed highway service with full quota of passengers.

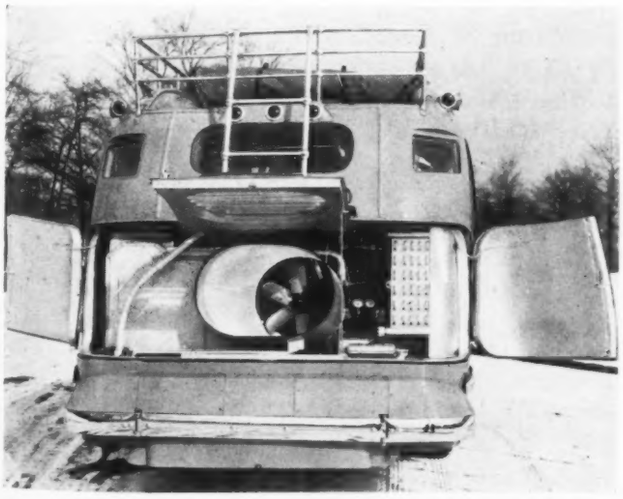


Fig. 1—Complete airconditioning unit is housed in a shallow compartment in the rear of a streamlined motor coach

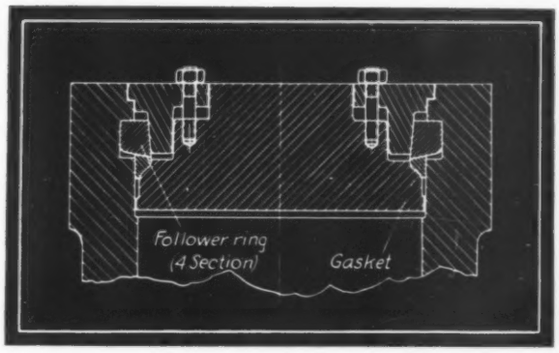


Fig. 2—Self-sealing effect is attained by means of this new type of high pressure head

Increased Pressure Tightens Seal

ATTAINMENT of absolute and permanent tightness of autoclaves and other pressure vessels, as well as pumps, valves and similar equipment subjected to varying conditions of pressure and temperature, is difficult. Oftentimes rather complicated methods of sealing have been resorted to.

The engineering firm of Friedrich Uhde of Dortmund, Germany, has recently developed and patented the sealing system shown in section in *Fig.* 2, as applied to an autoclave. The object of this design is to cause the internal pressure to exert a self-sealing effect through the action of the specially shaped heat-resisting gasket in conjunction with the high strength, four-section follower ring which "keys" into the bore of

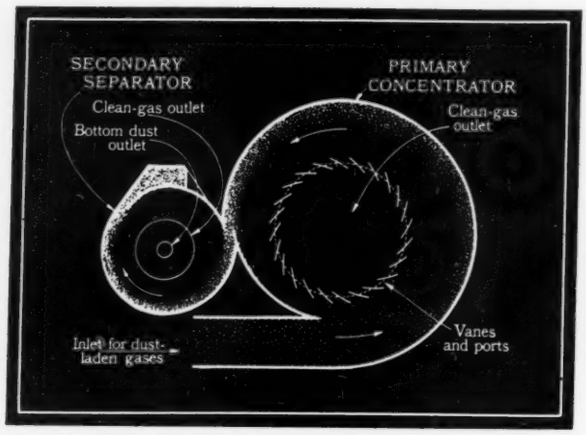


Fig. 3—High concentration of dust is effected by "skimming" from primary to secondary separator

the pressure cylinder, thus locking the head in place.

It will be noted that the component parts of the head are relatively few and simple in design, and that its quick and easy removal is possible. This unique self-sealing joint has stood the test under high pressures involved in chemical synthesis, oil refining and use of superheated steam.

Double Whirl Separates Dust

SEPARATION of dust from air and other gases is highly important today when closer and closer checks are being made on the amount of industrial dust discharged into the atmosphere. To be successful, a system for extracting fly-ash and other dusts should handle a large volume of gas at low operating cost, and still give efficient separation.

The "two-stage" idea has been applied in the collector system shown diagrammatically in *Fig.* 3. This apparatus, built by Buell Engineering Co. Inc., combines a primary concentrator of centrifugal fan type with a secondary separator of cyclonic type. As indicated by the diagram, the gas carrying the greatest dust concentration is skimmed from the inner periphery of the concentrator by the lip of the secondary concentrator. What is left in the primary concentrator recirculates, thereby being further separated.

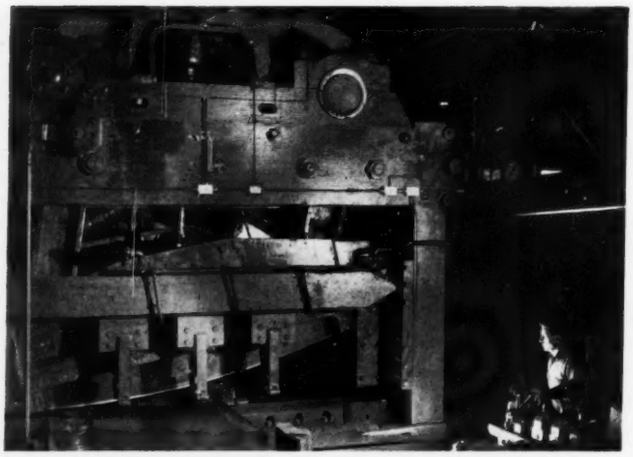


Fig. 4—Inspired by a rocking chair, this huge shear cuts wide steel plates without bowing them

Rocking Shear Leaves Plates Flat

WHEN cutting wide plates in steel mills by the use of straight edged shears, an annoying bowing or arching effect often occurs. While seeking a solution to this problem, A. W. Soderberg, chief engineer of the Homestead works of the Carnegie-Illinois Steel Corp., happened to observe a rocking chair in action. That gave him the inspiration for the huge rocking shear depicted in *Fig.* 4.

To test the "rocking chair" idea he first made a small wooden model in which sticks of chewing gum were used to represent the plates being sheared. The model snipped these off without any sign of the familiar bowing or arching effect. On the strength of this demonstration, the 80-ton shear shown was designed and built for use in connection with a 100-inch mill.

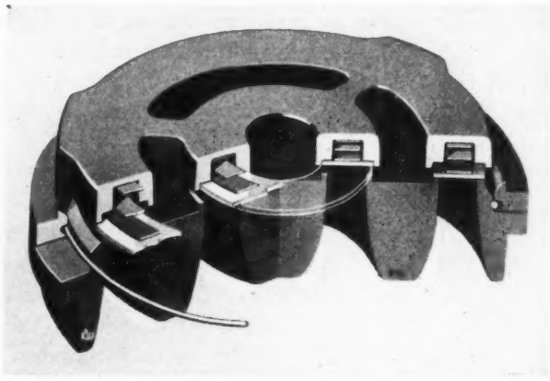


Fig. 5—Venturi-shaped ports and high lift disks assure free flow through this compressor valve

The principle involved is, that with the rocking blade no knife travel occurs after the bottom of the top blade passes below the top of the bottom knife.

Valve Has Air-Cushioned Disks

AUTOMATIC valves for air compressors should be quick and dependable in action, noiseless, durable, and should allow free passage of large volume of air. To attain these ends, Pennsylvania Pump & Compressor Co. has developed the valve shown in section in *Fig.* 5.

In this new valve, guard and seat are held together by a spring retainer ring which fits into a groove in the guard and snaps into a corresponding groove in the seat when guard and seat are pressed together. The

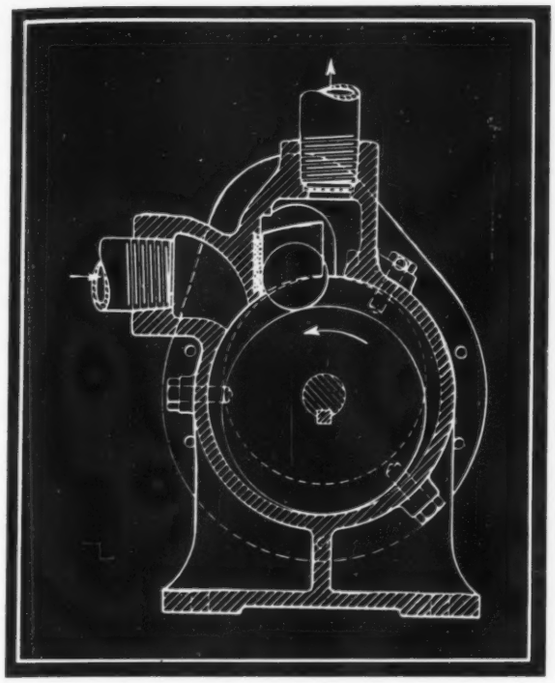


Fig. 6—Intake and discharge sides of revolving piston are separated by rolling cut-off

disks are annular flat plates of stainless steel. Because there is no flexing, these disks can safely be given high lift, thus increasing the capacity. Being circular, the smaller ones nesting within the larger ones, maximum linear inches of port in a given diameter are obtained.

The cylindrical helical springs also are of stainless steel. This rectangular wire is rolled "on edge" to increase its strength and to permit shortening the height of the spring, thereby minimizing depth of the valve pocket and cutting down clearance. Width of cross section of this spring is equal to width of valve disk, giving even bearing on and even seating of the disk.

Rolling Cut-off Reduces Friction

ONE of the problems in designing pumps of the revolving eccentric piston type is to provide a cut-off or abutment which will effectively prevent slip of liquid from one side of the piston to the other without introducing undue friction and wear.

This problem has been solved by the Anderson Rotary Pump Co. through the use of a free-rolling abutment resting on top of the rotor in a pocket in the pump casing. In *Fig.* 6, the action of this abutment is clearly depicted, this sectioned elevation showing the back of the pump.

As the eccentric rotor revolves in the direction indicated by the arrow, the rolling abutment rises and falls, in the meantime being held against its non-metallic seat (the dovetailed insert to the left of the roller) by the liquid pressure in the discharge side combined with the suction on the intake side. As arrows indicate, the left-hand port is the intake.

Permanent stuffing box packing and oilless bearings are provided and the pump is designed to handle non-lubricating liquids at 275-300 RPM.

Piles Them Up or Takes Them Down

MECHANICAL means whereby yard space can be saved and handling costs reduced by high piling of lumber for open air drying, have been worked out in the Hilke lumber piler shown in *Fig.* 7. This device, which is built by the Johnson Mfg. Co., also serves effectively as an "unpiler" after the lumber is seasoned.

The unit consists of a track-mounted steel structure carrying a double stand continuous elevator employing Link-Belt malleable chains both for lifting and driving, the drive being either by electric motor or gas engine. At suitable intervals on the elevating chains forks or carrying arms are fastened. Into these the sticks of timber are placed by operators at the bottom (or power end) of the machine. They travel in a ladder-like formation up and over the head-wheels at the top of the structure, then down until deflected to the men on top of the pile by the adjustable automatic unloading arms.

The unloading arms are bars set at an angle of 45 degrees to cam the lumber out of the forks of the carrying arms at a point convenient to the "top men."

Fig. 7—High piles of lumber are built up and taken down with help of vertical conveyor

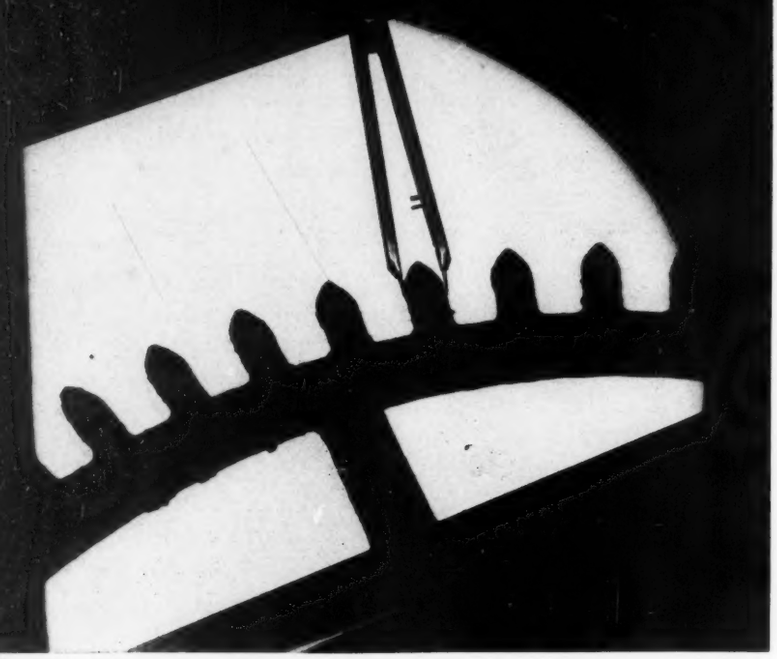


Fig. 1—By means of the profile projector, a tiny wrist watch train wheel is enlarged optically, allowing easy measurement and checking by inspectors and designing engineers

Optical Devices E

By Guy Hubbard

MECHANICAL applications of optical equipment are of long standing in the laboratory, but their use under actual industrial conditions has not been recognized as a design trend until recently. Even today the full possibilities of optical devices in machinery have scarcely been scratched. Many things still in the laboratory stage are destined before long to have great influence in the design and operation of industrial equipment, particularly in the direction of automatic inspection and the related technique of automatic sizing and quality control of work. In the ingenious adaptation of optical principles lies, to no small degree, the answer to that ever growing problem, "How can inspection methods keep pace with new production methods?"

Basic Principles Are Old

Aside from those involving electronics the basic principles underlying optical applications in industry have long been understood and their possibilities appreciated. Not so long, however, has suitable equipment been available for practical application of some of these principles.

Great credit is due the optical industry for its commercial development of such items as lenses giving flat field, straight lines and sharp definition at wide apertures; prisms of precise refracting power; mirrors which reflect with high efficiency from the exterior surface; optical flats for use in light-wave measuring, defraction gratings; monochromatic and polarized light sources; rugged shop microscopes; stroboscopic instruments, etc.

Machine builders should by all means turn to the optical industry for equipment of this nature and for the highly specialized technical advice and service involved in modifying it for and designing it into machinery. It has been through the co-operative effort between the machinery industry and the optical industry that many successful developments such as are illustrated in this article have been brought about.

With the help of comparatively simple equipment, light can be made to do a number of things useful in connection with machines. As a "weightless lever" it can be made to magnify minute motions, as in the case

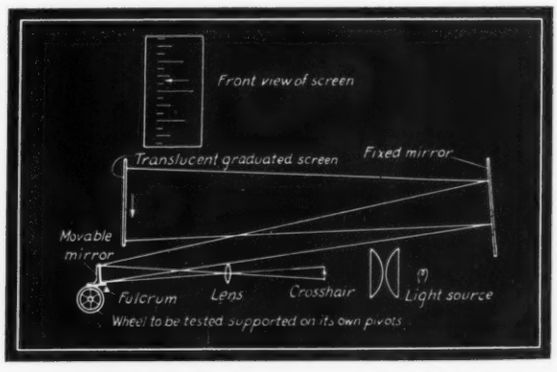


Fig. 2—Concentricity of escape wheels is tested by the action of "weightless lever of light"

of the gaging instruments shown in *Figs.* 2, 6 and 8. It can be made to magnify small objects by projection, as indicated by *Figs.* 1 and 3; by direct magnification as in *Figs.* 4, 5, and 9; or by reflected magnification as shown in *Fig.* 10. While these are all in the nature of visual applications, light also can be made to do work through the intervention of electronic tubes which act as relays to build up its power to a usable degree. This use of the power of light as the medium for the actual control of a mechanism is featured in the article which appears elsewhere in this issue and which deals with design and operation of the Ray-O-Lite rifle range.

Magnification by projection has proved a great boon to makers of small mechanisms—watches in particular.

es Enter Machine Design Field

To use the words of M. F. Manby, chief engineer, Hamilton Watch Co., "Use of profile projecting machines by the engineering department permits minute parts to be thrown up on a screen and thereby studied in much the same manner as a mechanical engineer in the railway field might examine a locomotive driving rod." This is well brought out in *Fig.* 1, which shows the profile of a section of the teeth of a wrist watch train wheel when projected 100:1 on the ground glass screen of a Bausch

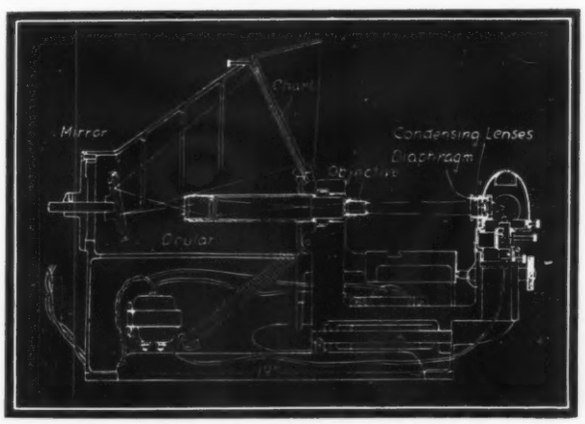


Fig. 3—Reversal of light by mirrors makes the comparator a compact, self-contained mechanism

& Lomb projector.

The diagram, *Fig.* 2 reveals the optical system of an ingenious gage for checking the concentricity of escape wheels of Hamilton watches. This makes use of a "weightless lever" of light reflected from a pivoted mirror of galvanometer type, the pivoted mounting of which rests on the rim of the pivot-mounted wheel being checked. The image of a cross hair, after passing through the lens system, is reflected from the pivoted mirror against a fixed mirror, thence against a fixed mirror which throws it back onto a ground glass screen directly in front of the operator.

Compactness and convenience of operation now is achieved in projection equipment by a similar "folding up" of a long path of light by reversing it by mirrors. This is illustrated in the case of the Jones & Lamson bench comparator, of which a cross sectional diagram appears as *Fig.* 3. Instruments of this kind not only are characterized by the perfection of their optical parts and their extreme mechanical accuracy, but also by their decidedly rugged construction. In design they are comparable to the production machine tools with which they are so closely associated in their practical applications.

A case of a relatively simple lens system for direct magnification is that of the Toledo Plaskon duplex scale, shown in *Fig.* 4 with its cover removed to reveal the mechanism and lens mount assembly. Two control knobs on the merchant's side of the base (left side) shift the lens mount from the low to the high price range, while the right knob tilts the lens mount up or down to bring it to proper reading for high or low counters or tall or short clerks.

A machine making use of a built-in microscope is

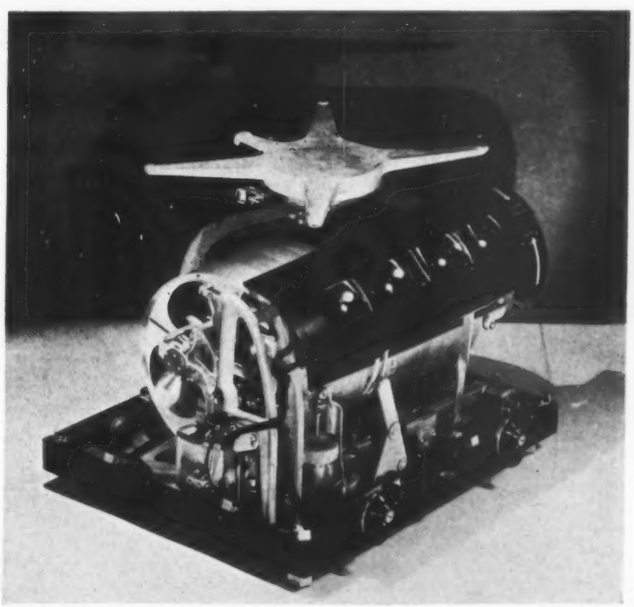


Fig. 4—Direct magnification of figures on drum insures quick, accurate reading of this computing scale

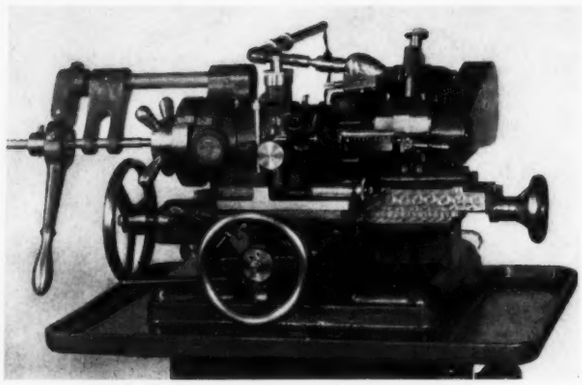


Fig. 5—Built-in microscope is used in this special grinder in bringing work to exact size and shape

depicted in *Fig.* 5, this being a special grinder designed by the Waltham Machine Works for finishing four reamer blades incorporated in a tap for threading Dardelet nuts. The blades are ground to an angle, each to a different height, which must be measured before removal from the grinder. The different heights are obtained by means of a cam cut to the required steps—the diameter of the highest blade being determined by means of a Bausch & Lomb microscope. Its eye piece has fixed lines showing angles of the sides of the blade. Another line is adjustable to the angle of the top of the blade.

The microscope itself can be adjusted horizontally in two directions at right angles, and also vertically. Original setting of the microscope is made to a master gage of exact dimensions, to which the lines are calibrated. Then the work is ground exactly down to the lines as seen through the microscope, illumination being furnished by a small electric bulb.

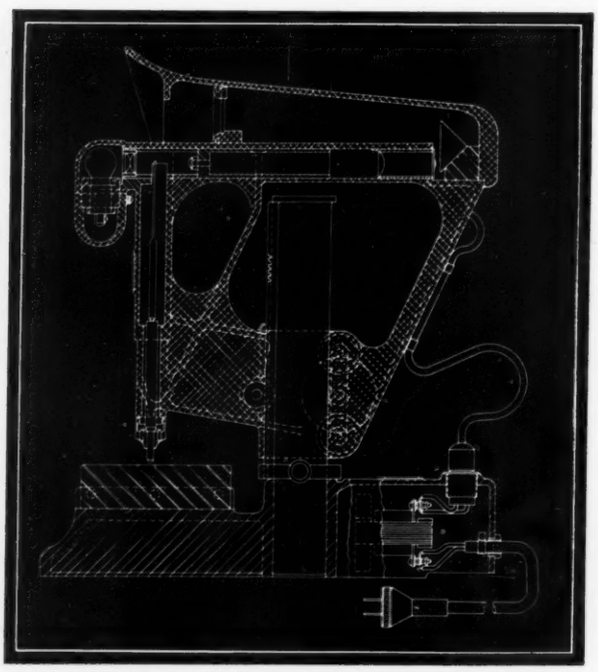


Fig. 6—Mechanical deflection is multiplied optically up to 10,000 times on this type of visual gage

Secondary amplification of the movement of a pointer which by the deflection of four metallic reeds already has been amplified mechanically from the minute movement of the movable finger of the gage, is accomplished optically in the Sheffield visual gage which is shown in section in *Fig.* 6. These gages are built in magnifying power from 500 to 10,000 times. The smallest graduations on the dial of the 10,000-times gage is .00001. As the dials are 4 to 5-inches wide, readings actually can be interpolated between these graduations, the image or shadow of the pointer being sharply defined.

Use of the light wave system for industrial measurements was suggested by the famous meterologists Rogers and Bond nearly sixty years ago. The system is finally becoming of considerable commercial importance and much more will be heard of it as manufacturing limits are further tightened. *Fig.* 7 shows a light wave micrometer of 1-inch capacity made by the Van Keuren

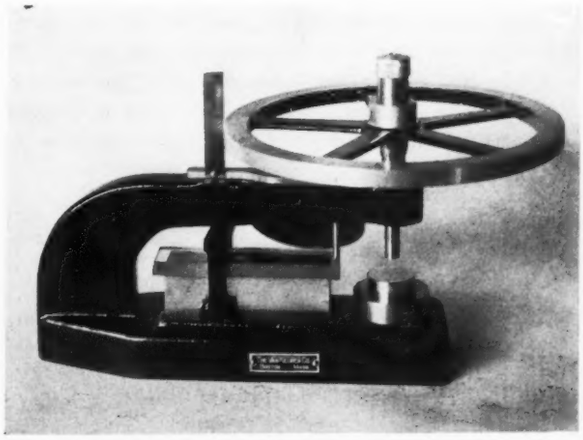


Fig. 7—Light wave interference bands indicate contact pressure in .00001-inch micrometer

Co. for shop use. Light wave interference bands are used in this instrument to give extremely sensitive indications of contact and gaging pressure, enabling duplication of readings within one-tenth of a graduation, or .00001-inch.

The instrument has an accurate micrometer head with 6-inch wheel. The light wave equipment consists of a ¾ x 3-inch steel flat fastened to the base, a 3¼-inch glass flat held in contact with it by a coil spring, and connected to the micrometer arm by a tension rod. A red selenium glass screen provides monochromatic light, which brings out the interference bands between the glass and steel flats.

Any bending of the micrometer arm—however minute—causes the light wave bands, which resemble the color bands on a soap bubble, to move toward the left. A bare movement of the bands indicates contact at zero pressure, appearance of one additional band indicates 6 ounces pressure, two bands 12 ounces, etc. The index of the micrometer is set to zero and measurements are then taken with the same movement of

bands as in the zero position.

Fig. 8 shows the optical arrangement in connection with the "Pressure tailstock" of the Pratt & Whitney standard measuring machine. This is a bench micrometer with a 3-foot bed, which is capable of measuring under shop conditions to accuracy of .00001 inch. The basic purpose of the pressure tailstock is to provide measuring pressures ranging from 8 ounces to 3 pounds. This is accomplished by directing a beam of light through the series of lenses, prism and mirrors to form an image on a ground glass field. The measuring anvil actuates one mirror in this optical train, the movement of this mirror being magnified in the movement of the image (which is arrow-shaped) on the ground glass. This image is always brought to coincide with the standard reference line on the ground glass, thus giving the standard degree of gaging pressure.

The automotive industry is making use of an increas-

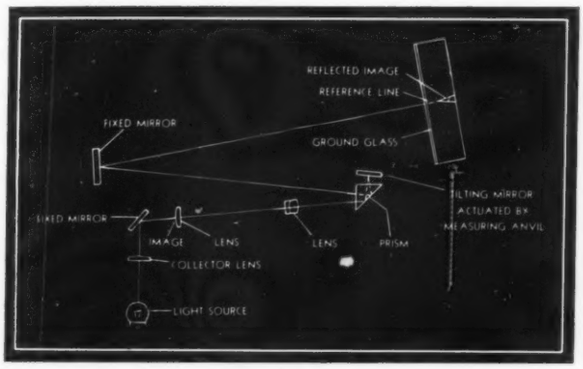


Fig. 8—Tailstock pressure of measuring machine registers through system of lenses, prism and mirrors

ing number of optical devices, both in connection with experimental work such as study of high speed mechanisms in motion, and in connection with production work. As an example of the latter, consider the Zeiss camshaft tester of which a general view appears as *Fig.* 9.

Exactly timed opening and closing of valves is recognized as vital to the efficiency of an internal combustion engine. Hence accuracy of camshafts must be maintained. The apparatus shown is designed to measure quickly and accurately the shape and angular position of the lobes of the cams, their lift in any angular position; the relative angular position of the numerous lobes is positively ascertained. The equipment comprises the tester proper, a Zeiss optical dividing head with footstock, and a bed on which these elements are mounted.

The tester element consists of a triangular foot carrying an upright steel column with vertically adjustable spiral microscope. Fastened to this microscope below the objective is a glass cube made up of two 90-degree prisms. Laterally to this prism cube and slidable axially on ball bearing rollers in a guide integral with

Fig. 9—Size, shape and relative location of automotive valve cams are checked by microscopic device

the microscope housing, is a horizontal contact rod with polished steel scale in its side facing the prism cube. The tip of this rod bears on the cam lobe with constant pressure maintained by cord, pulley and weight.

In the microscope housing, opposite the contact rod and on the other side of the prism cube, there is an aperture for entrance of light. Light from a standard frosted bulb falls through this aperture over the double prism onto the contact rod. It reflects upward into the microscope to produce—together with the spiral microscope scale—a compound image enabling readings to .00005 inch.

The optical dividing head also embodies a microscope which allows angular readings in minutes and fractions of minutes within 20 seconds of accuracy. This same head also is used for accurate circular dividing in milling, etc.

As a final feature of this article there has been selected an optical application which is not of the precision variety but which nevertheless is highly ingenious and which accomplishes with speed and thoroughness the inspection function for which it is designed. This device, developed by Cleveland Union Engineering Co. and illustrated diagrammatically in *Fig.* 10, is used to reveal flaws, cracks, dirt and other defects in the walls and on the surfaces of bottles and jars, and also to reveal turbidity and foreign substances in the contained liquid.

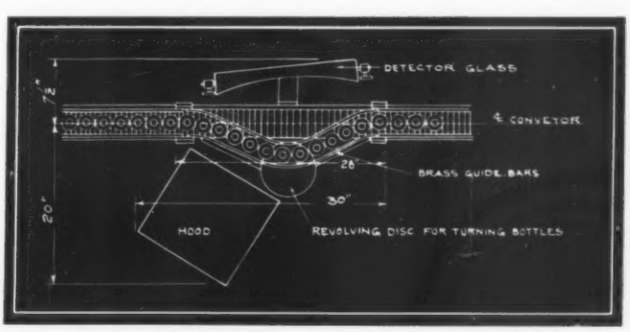


Fig. 10—As bottles revolve in front of concave mirror, defects are shown up by reflective magnification

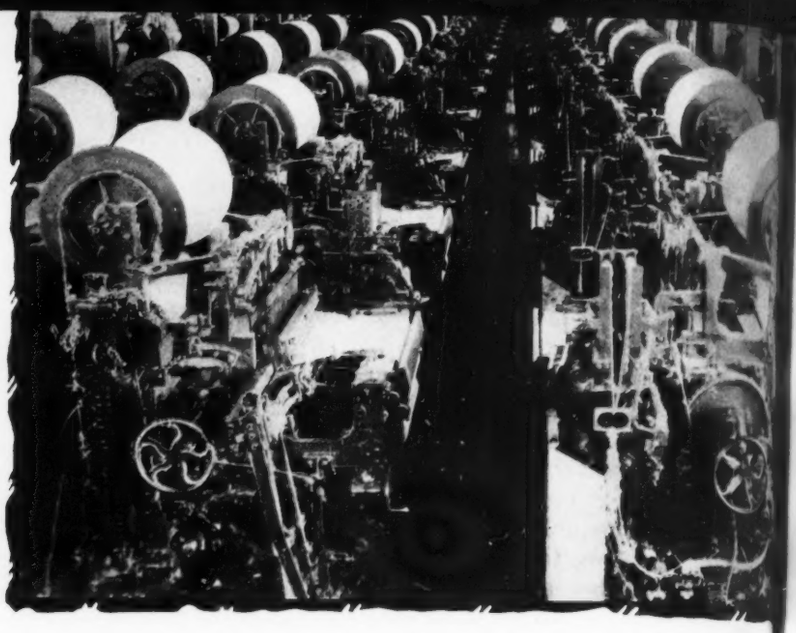


Fig. 1—Method of lubrication in a textile mill is of paramount importance as woven fabrics must be protected from oil and grease

Engineering Department Should Specify Correct Lubricants

By Fred B. Jacobs

CORRECT lubrication of machinery is a major industrial problem today. No matter how carefully a machine is designed, it will not function efficiently if improperly lubricated. In the design of any machine, chief engineers and designers see to it that all bearings are correctly proportioned, that proper clearances are specified to accommodate oil films and that means are provided for getting the lubricant to the bearings.

However, the foregoing is only part of the story. The correct lubricant for a given purpose must, in many cases, be specified, for the most adequate lubricating system will fail in actual use if the wrong lubricant is employed. Some years ago when the purchasing agent had the last word about purchasing lubricants he often bought the cheapest grade the market afforded. And when machines failed in operation the machine manufacturer was blamed. Today the picture has changed. Through exhaustive experiments, laboratory and practical tests of numerous lubricants, the manufacturer of high-grade machinery knows the lubricants best suited for specific purposes. This information he gives to the machine user who is not troubled, therefore, with selecting the proper lubricant.

An excellent example of this procedure is seen in the practice of the

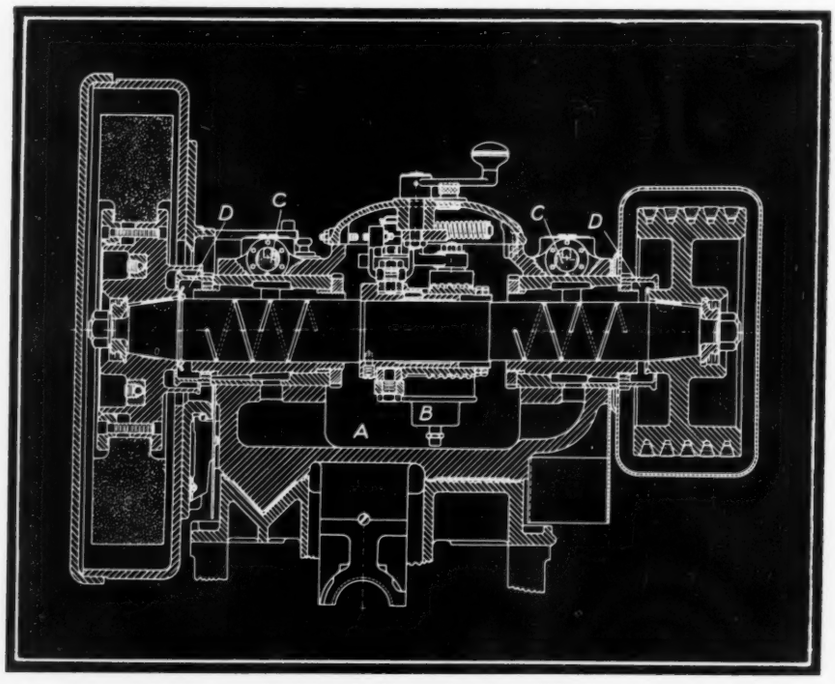


Fig. 2—Makers of this high - speed grinding unit specify lubricant to use because of its closely fitted bearings

Crompton & Knowles Loom Works, Worcester, Mass. This company manufacturers looms for weaving the finer fabrics such as silks, rayons, and high-grade cotton goods. Weaving of these fabrics must be done on precision looms and in this type of machinery adequate lubrication is of paramount importance. The looms in question are lubricated either by pressure grease systems, one-shot oil lubrication or simply with an oil can. The system is optional with the customer, its type depending principally upon the size of the plant in which the machine is to be used and the conditions under which it operates. A large mill would ordinarily choose a pressure grease system, which would be periodically tended by a man employed for this purpose; whereas small mills with one or two machines would select a simple oiling system that the operator of the machine would be able to care for himself. A loom of the type under discussion has about 500 lubricated bearings and moving surfaces.

Table I

Lubrication Guide

Specifications of lubricants for Crompton and Knowles looms are classified under five headings which include two general purpose oils and three general purpose greases.

Specification #1—Oil for breaking in looms.
Viscosity Saybolt Universal 225 to 300 seconds at 100°F.
Flash point minimum 340°F.
Burning point minimum 390°F.
Specific gravity 19.0 to 22.5
Color #5 N.P.A. standard

Specification #2—Oil for normal operation.
Viscosity Saybolt Universal 500 to 750 seconds at 100°F.
Flash point minimum 375°F.
Burning point minimum 425°F.
Specific gravity 18.0 to 22.0
Color #5 N.P.A. standard

Specification A—Grease for roller bearings.
A.S.T.M. Penetration 250/300 approx.
Soap *Soda
*The grease is to have a soda soap base and should be worked.

Specification B—Grease for plain bearings.
A.S.T.M. Penetration 250/300
Soap *Lime
*This grease is to have a lime soap base.

Specification C—Grease for starting looms.
For starting looms equipped with grease fittings we recommend a fluid lubricant such as that manufactured by the Alemite Corporation or by the New York, New Jersey Lubricant Co.

Intensive laboratory and actual working tests of practically all lubricants on the market have been made by the company which is, therefore, in a position to specify the correct lubricant. Shown in Table I is a printed form supplied by the manufacturer with each machine giving lubrication specifications for operating the machine. As the table shows, two different types of oil are specified for looms equipped with oil fittings and three types of grease for those to be lubricated by grease systems. The specifications go into some detail on the specific gravity, viscosity, burning point and other properties of the oil and also specify whether grease is to have a soda or lime soap base. In another table supplied by the manufacturer the names of oil refiners and the various tradenames of their products are given. In still another chart complete lubricating instructions for both oil and grease system are supplied.

No matter how carefully a loom is built it will not run properly if not installed in a perfectly level condition. The reason is obvious: If the loom is not level when lagged to the floor it will be forced out of alignment and the shafts will cramp in the bearings. To make sure that each loom is leveled correctly, a leveling chart is sent out with each new loom. The chart shows how the lower shaft and each side frame must be tested. If these three points are level, assurance may be had of correct operation without cramping. If the loom is cramped out of alignment no amount of lubrication will cause it to function properly.

In *Fig.* 1 is shown a typical weaving room in a tex-

TABLE II

BEARINGS: Plain or Sleeve Type	Wick Feed		Garnet Oil CC
	Oil Cups		Warrior or Coss Oil
	Mechanical Oilers		Garnet Oil CC or Commander Oil B
	Grease Lubricated		Opaline Pressure System Grease
Ball and Roller	Oil Lubricated	Above 1800 r.p.m.	Cordymo Oil
		Below 1800 r.p.m.	Garnet Oil BB or Commander Oil A
	Grease Lubricated	Above 1200 r.p.m.	Bearing Grease AF
		Below 1200 r.p.m.	Opaline Universal Grease
GEARS AND SPEED DRIVE UNITS: Worm Reduction	Pressure Lubricated		Garnet Oil CC or Commander Oil B
	Sump Lubricated		Modoc Cylinder Oil Dark
Feed Gears	Exposed Drip Oiled		Garnet Oil CC or Commander Oil B
	Exposed Swabbed		Garnet Oil CC or Commander Oil B
	Enclosed Splash Lubricated		Modoc Cylinder Oil Dark
High Speed Drive Units	Enclosed		Modoc Cylinder Oil Dark
	Exposed		Opaline Pressure System Grease
SLIDES, WAYS AND CONTROLS	Pressure Oiled		Garnet Oil CC or Commander Oil B
	Sight Feed Cups		Warrior Oil or Coss Oil
	Hand Oiled		Warrior Oil or Coss Oil
	Grease Lubricated		Opaline Pressure System Grease
CHAINS	Drip or Wick Oiled		Garnet Oil CC or Commander Oil B
	Bath Oiled		Warrior Oil or Commander Oil A
	Grease Lubricated		Opaline Pressure System Grease
ELECTRIC MOTORS	Oil Lubricated		Cordymo Oil
	Grease Lubricated		Bearing Grease AF

tile mill. Imagine for a moment what would happen if each weaver lubricated the looms in his care at the time and in the manner which he chose. Some looms might receive adequate lubrication, others would be seldom touched. The results would be excessive maintenance costs as machinery which is not lubricated correctly is short lived. For this reason the looms in efficient textile mills are oiled at stated intervals by operators who are detailed for this work. The Crompton & Knowles Loom Works encourages this practice. By following the directions given in the various charts furnished by the manufacturer one may have complete assurance that the machine he is using will give maximum life.

Builders of precision grinding machinery are confronted with peculiar lubrication problems. (*Fig.* 2 is a section through the wheel head of a 10-inch, cylindrical grinding machine made by the Norton Co., Worcester, Mass. An idea of the massiveness of the construction is gained from the fact that the wheel head weighs over a ton. The grinding wheel spindle is 35⅝ inches long with bearings 3½ x 8½ inches and 3¼ x 7 3/16 inches. The spindle bearings are flood lubricated with filtered oil. Referring to *Fig.* 2, *A* is the oil reservoir and *B* the geared pump which conveys the oil through a filter (not shown in the illustration). From the filter the oil passes through pipes to the bulls'-eyes, *C,* where its flow to the spindle bearings is under control. The oil works through the bearings and is thrown off at each end by the oil slings, *D,* and then flows back into the reservoir to be used over again.

Universal spindle oil is used which has an approximate specific gravity of 31. Its viscosity is 185 at 100 degrees, Fahr.; 46 at 210 degrees. Flash point is 435 degrees, Fahr., and it fires at 495 degrees. As the bearings on this grinder run nearly metal to metal they heat to a certain extent in use. Thus a high-grade oil is imperative as inferior oil would speedily ruin the bearings. It is to the advantage of the manufacturer to give his customer specifications for selecting the correct grade of oil.

Methods followed in designating certain oils and greases for specific purposes vary greatly, of course, with different manufacturers. The United Shoe Machinery Co., Boston, makes a full line comprising over 20 machines used in finishing the bottoms of shoes. As these machines are used in manufacturing plants all over the country, the lubrication problem is of the utmost importance. At regular intervals this company has its lubricating problems investigated by leading lubrication engineers of oil refiners. From their findings proper oils and greases can be specified for lubricating bearings in the machines. Mineral oil has been found to be best suited for certain bearings. A high-speed spindle on an edge-trimming or heel-breasting machine will call for a much lighter oil than is necessary for a comparatively slow-moving shaft, and for this reason a mineral oil possessing unusual properties is needed.

According to one oil company, a study of woodworking equipment has demonstrated that despite an extensive variety of machinery and a wide range of operating functions, the lubrication requirements of the woodworking industry classify themselves into four major essentials. The wearing surfaces of the equipment comprise (1) bearings, (2) gearing, (3) slideways and controls, and (4) chains. After an exhaustive study of these requirements the oil company compiled the specifications shown in Table II.

TABLE III

PAPER MILL MACHINERY

Fourdrinier: Wet End—Pressure Lubricated—Plain or Anti-Friction Bearings: *Alemite Light (No. 33) or Medium (No. 34).*

Dry End—Calender Rolls—Anti-Friction Bearings: *Alemite No. 39 or Pyro (No. 41).*

Open Box Type Bearings—Steam Pressures above 25 lbs.: *Alemite Block Lubricant.*

Steam Joints — Pressure Lubricated: *Alemite Water Pump Lubricant or No. 40.*

Trimmers and Reelers—Pressure Lubricated: *Alemite Solidified Oil (No. 32) or Light (No. 33).*

Beaters—Open Box Type Bearings: *Alemite Block Lubricant or felt saturated with Alemite Light (No. 33).*

Jordans—Pressure Lubricated: *Alemite No. 38 or Pyro (No. 41).*

Converting Machinery—Pressure Lubricated: *Alemite Solidified Oil (No. 32) or Light (No. 33).*

Charts Prepared for Many Machines

Another company has worked out complete specifications pertaining to the lubrication of practically every type of machine. As an example, the recommendations for paper machinery are given in Table III.

Several oil companies in conjunction with the engineers of different machinery manufacturing concerns have prepared lubrication charts, covering the requirements of the complete range of operating conditions. Heavy machinery such as steel-mill equipment has been surveyed and studied, and suitable charts have been prepared which make lubrication a simple matter.

Nobody questions the statement that correct lubrication pays dividends. The large amount of research work done by both machinery manufacturers and oil refiners has aided materially in eliminating guess work. Information obtained in tests is passed along to the machine user in one of several ways. As this article points out, charts and diagrams compiled by both machinery builders and oil refiners are supplied. Many manufacturers are finding that a nameplate attached to the machine which specifies correct lubricants saves the customer and themselves time and money. The practice is to be encouraged as it forms a permanent record that cannot be lost or mislaid.

Acknowledgment is made to the following companies for their courteous assistance in the preparation of this article: Socony-Vacuum Co., Sinclair Refining Co., Standard Oil Co., Sun Oil Co., Houghton & Co., The Texas Co., and Alemite Division, Stewart-Warner Co.

Rubber Affords Protection for Machine Parts

By Fred Kelly

Fig. 1 — Plating this propeller with rubber deadens sound and protects the metal from corrosive fumes

IN RECENT years the use of rubber on metal parts as a protection against both abrasion and corrosion has expanded rapidly. Acid fumes or solutions soon destroy expensive metal parts though alloyed with corrosion-resistant metals. Abrasion accounts for many costly replacements. Such parts as impellers in flotation tanks, castings on sandblasting machines, centrifugal pump casings, have a short life unless protected in some manner.

Early attempts to cover metal parts with rubber were not entirely successful. Sheets of rubber were cut to fit the part and then vulcanized to the metal in any of several ways. A vulcanizing process is limited, however, to those parts that pieces of rubber can be cut or molded to fit. To cover the majority of machine parts successfully it is necessary that a liquid rubber solution come in contact and adhere to the entire surface. Rubber plating has been developed to meet this need.

As the phrase implies, rubber plating is a method of electrolytically depositing rubber on metal parts or forms. Each minute particle in a latex bath carries a small electric charge and the charges on all the particles are negative. If this charge is neutralized, the particles do not remain suspended, but deposit and coagulate on the form from which the neutralizing charge came. At first an electric current was utilized as in most plating operations, but it was found that a coagulant which would produce the electrical action chemically was more suited to machine parts. The neutralizing charge must be and is positive since the particles themselves are negative. For this reason the process is called the Anode process as the form on which the rubber is deposited furnishes the neutralizing positive charge.

A part to be plated is coated with the coagulant and then placed in a bath of liquid latex which adheres to the metal. Thickness is proportionate to the time the part is held in the bath. Maximum thickness is about ⅛-inch, the limit being reached when the action of the coagulant loses its neutralizing power because of the layer of rubber over it. The plated rubber may be processed so that it is soft, semi-hard or hard depending upon the type of service for which the part is used.

A soft rubber product is best for combatting abrasion, for insulation and as a cushioning medium. Hard rubber resists high temperatures, is less liable to tear from the part to which it is plated and is well suited for lining tanks or covering plating equipment. An intermediate hardness combines the advantages in some degree of the two extremes.

In many cases, revolving parts for instance, it is desirable and often essential that the plated rubber be firmly bonded

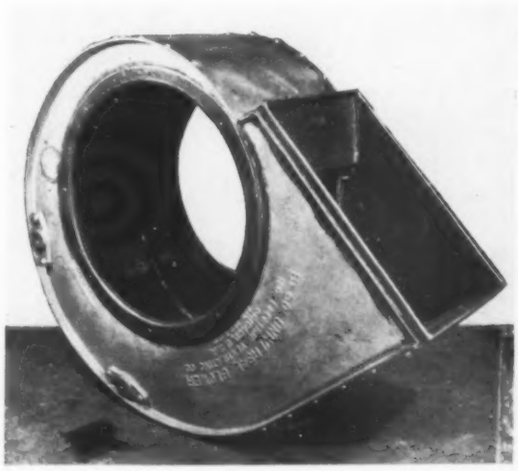


Fig. 2 — Acid fumes have little chance of harming inside of rubber coated exhaust blower

to the metal. A process has been developed whereby soft rubber coatings are adhered firmly to the metal base. This vulcanizing process can be used either in conjunction with the Anode plating operation, or simply to adhere large rubber sheets to uniform surfaces.

For covering machine parts subjected to excessive abrasion, a thicker rubber coating is necessary than can be obtained by plating. In such cases, rubber is molded to fit exactly the part to be covered and then bonded to the metal. Brass or copper is plated on the part giving a surface to which rubber can be easily bonded. Any thickness can be made by this method, but, of course, only parts the shape of which can be duplicated by molded rubber lend themselves to this method.

Impellers and hood wearing plates in flotation machines have been covered with molded rubber to resist abrasive materials. These parts are made of the best quality hard iron but the abrasive nature of the material being treated caused them to wear rapidly. With a covering of molded rubber the life of these parts is six or seven times that of an unprotected metal part.

Casings on centrifugal pumps have also been lined with molded rubber and bonded to the outer shell. Resistance to wear has been increased tremendously and the rubber has been found to hold its shape, even though under considerable pressure.

An example of rubber plating to reduce corrosion is shown in *Fig.* 2. The exhaust blower is lined with a thin rubber coating as protection against sulphurous fumes. The fan which rotates in the casing is also rubber plated, providing a unit free from attack by corrosive fumes.

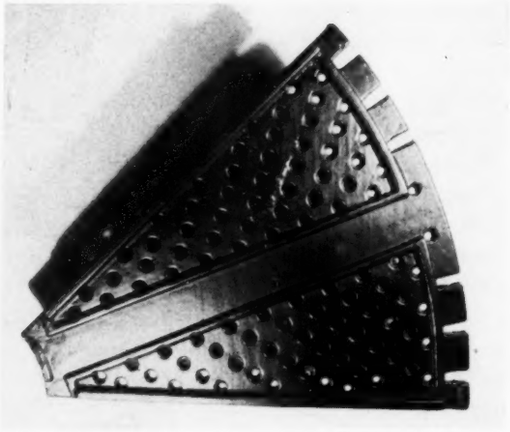


Fig. 3—Soft rubber plated on this casting protects it from abrasive particles

Fig. 4—Firm grip and attractive color are obtained on airplane steering wheel by rubber covering

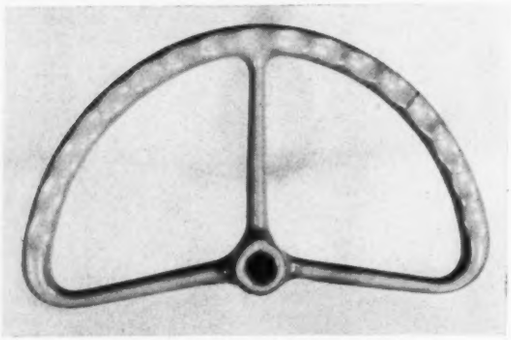


Fig. 5—Oil-resistant rubber has been used to cover spring, subjected to corrosive attack

Fig. 6—Rubber-covered loud speaker housing is insulated from tone destroying vibration

Rubber has been found to have less resistance when moving through liquids or gases than metals. An appreciable reduction in horsepower is noted in driving a rubber-coated impeller in liquid over the plain type. This reduction in resistance is small in air, amounting to only a few per cent, yet it is claimed that the noise of whirring propellers has been decreased by rubber coating. *Fig.* 1 illustrates a propeller plated with hard caustic-resisting rubber. Sound deadening is best accomplished with soft rubber, but the peripheral speed of the part must be kept within certain limits to prevent the covering breaking loose.

A large steel casting, *Fig.* 3, the base of a sandblast machine, has been plated with soft rubber to reduce abrasion. Because of its shape and the number of holes in it, covering with molded rubber would have been difficult. The airplane steering wheel, *Fig.* 4, has been plated with colored rubber, giving a pleasing appearance, firm grip and long life.

Oil-resistant, synthetic rubber is being used successfully for plating parts. It has found many applications in machines as a cushioning agent and an insulator against vibration and noise. Artificial rubber now serves another purpose, that of giving a protective covering to parts operating in oil and grease while exposed to corrosive fumes. The coil spring shown in *Fig.* 5 was given a protective coating by dipping in this medium. Like ordinary rubber, the artificial type may be bonded to metal surfaces, permitting its use on revolving

(*Concluded on Page* 55)

Electricity Scores Again —

Light Acts as Bullet

By L. E. Jermy

Fig. 1 — Above — Photo-electric cells serve as targets. These are mounted in center of ducks which travel around on V-belt

ELECTRICAL highspot of the decade, the photo-electric cell or electric-eye has aided the designer of machines to develop units not hitherto considered possible. As a color sorter, an automatic inspector, a counter of vehicles of parts, a switch for operation of neon signs, a temperature observer for heated metal, or for countless other automatic operations, this type of light-sensitive device has already made an enviable place for itself in the minds of designers.

Applications of the cell have, in the majority of cases, been made to machines of a relatively special nature with the result that in the past their production and use has been somewhat restricted, considering their wide possibilities. That this picture is destined to change, however, could not be better illustrated than by their application to the Ray-O-Lite rifle range discussed in this article, and depicted in *Fig.* 1.

In the development of this patented amusement ma-

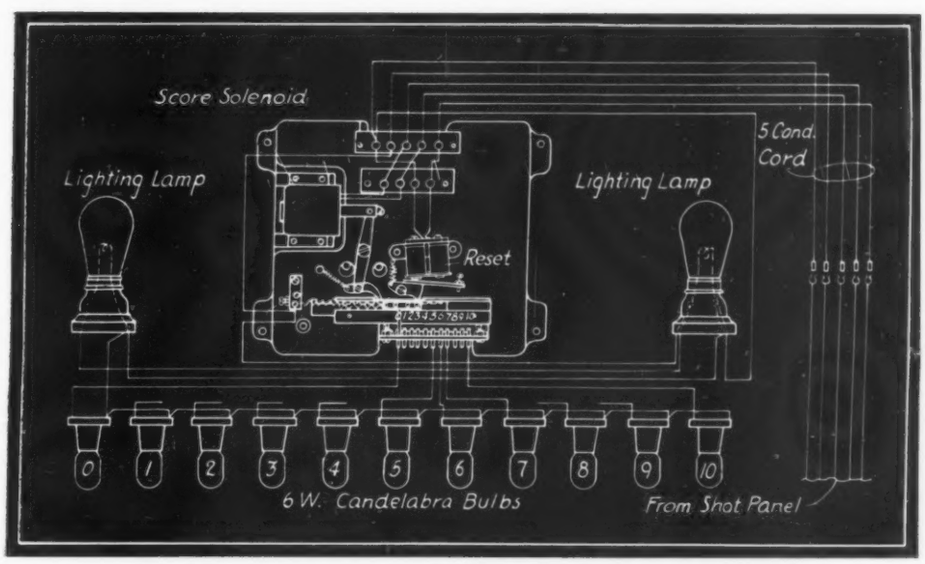


Fig. 2 — Right — Score-indicating section of machine incorporates row of bulbs which light successively as direct hits are made

chine the J. P. Seeburg Corp., Chicago, has utilized not only the electric eye but relays, solenoid, limit switches and other electrical devices to produce an efficient and foolproof unit—and it necessarily must be both because, if not efficient too much servicing would be required; if not foolproof, the profits from operation might easily be negative!

A brief description of the operation of this machine will be of interest, both from the standpoint of the devices involved and also because many MACHINE DESIGN readers undoubtedly have seen and operated one of these ranges.

Upon insertion of the necessary coin in the slot at the gun stand, diagrammatically shown in *Fig.* 3, the shot counting mechanism (ten shots being allowed) is reset to zero. At the same time the score counting mechanism is reset if it indicates hits from previous operation. These two mechanisms—the shot counter and the score counter—are similar in design, incorporating the familiar ratchet and pawl as may be seen in *Figs.* 2 and 3. The pawls are solenoid-operated respectively through impulses from the trigger switch in the gun and from the electric eye if a hit is made.

Simultaneously with the resetting of the counting mechanisms, a gear-motor which drives the ducks around is started through the coin switch and a relay on the main control panel. The electrical circuit also is closed at the time of coin insertion to enable the rectifier to furnish direct current for the various operating relays, besides the trigger circuit, target drop, and the scoring circuit.

Amplifier Provides Adjustment

Pressure on the gun trigger lights a "cartridge" bulb in the rear of the gun barrel and the beam of light is directed through a small hole at this point and through a lens at the far end of the barrel. Thus extreme accuracy is possible at distances of twelve to fifty feet from the moving ducks carrying the photoelectric cells. Adjustment is obtained by varying the amount of light necessary at the cell to operate the duck-drop solenoid. In making the adjustment, if only half a light spot registers on the cell and the duck drops, the amplifier is set for too easy operation, and if a complete full hit is necessary it is set too hard.

When a hit registers at the photocell a solenoid in the duck drive, *Fig.* 3, operates a tripper bar to release a

(*Concluded on Page* 90)

Fig. 3—Wiring diagram shows hook-up of gun, photoelectric cells, amplifier, solenoids, relays and ratchet reset device

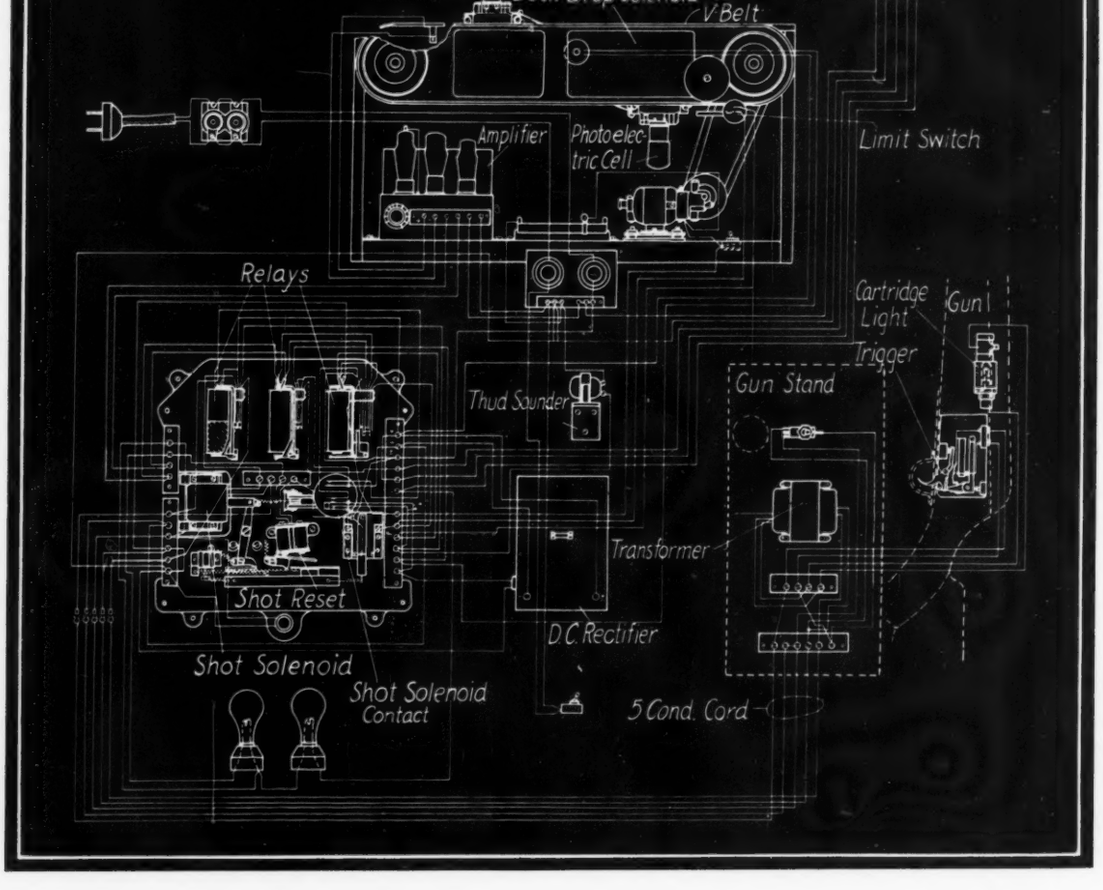


Fig. 1 — Sliding member engages with gear clutch to initiate reverse

Fig. 2 — Throw-out shoe prevents high-speed clutch engaging with main clutch in shifting

Fig. 3—No relative movement between high-speed clutch members allows smooth shifting

By Austin Wolf

Automatic Transmissions Prove Foolproof Unit

EFFICIENT operation of a fleet of Chicago busses equipped with automatic transmissions has practically proved the worth of these units. There has been an increase in safety as indicated by the reduced number of accidents, and decreased driver fatigue by the elimination of thousands of gear shifts and declutchings during a day's work. The smoother operation of the busses equipped with automatic transmissions has been distinctly noticed by passengers who avoid the old type equipment. During the time the automatic transmissions have been in use not a single universal joint drive or axle shaft has been broken due to shock loads. This is particularly interesting in a rear-engined installation where the close coupling of the units prevents the desired resiliency of the previous long transmission line.

The "Mono-Drive", used in this application, consists of a planetary type of transmission mechanism

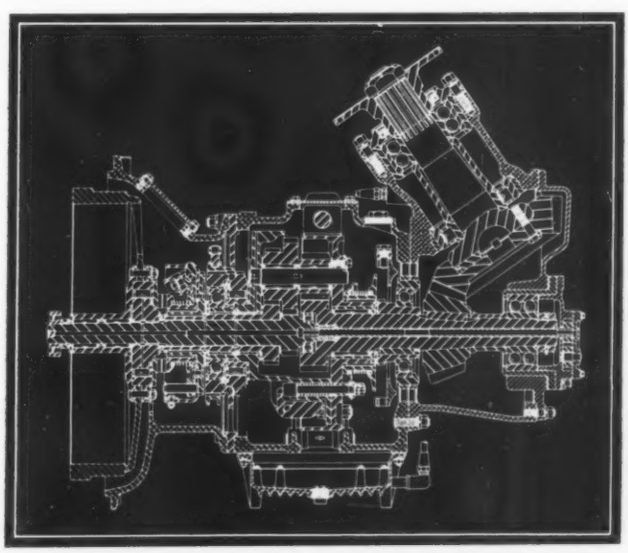


Fig. 4—Relation of parts in the three-speed, automatic transmission is shown in this cross section of unit

This article was presented as a paper by Mr. Wolf at a recent meeting of the Society of Automotive Engineers.

with three speeds forward and one reverse and with automatic control. The automatic clutch shown in *Fig.* 5 consists of two internal shoes which are expanded by centrifugal force through governor weights and their connecting linkage and two pressure springs. The clutch drum with which the shoes contact is part of the transmission assembly. Two centrifugal weights are used and they are connected through a primary toggle to an equalizer, from which point a link extends to the secondary toggle mechanism that expands the shoes at each end. The clutch starts to engage at about 400 RPM of the engine and the maximum effort of the weights is reached at 800 RPM at which speed the clutch is fully engaged. Any additional pressure of the shoes on the drum is due to centrifugal force acting on the shoes themselves. The

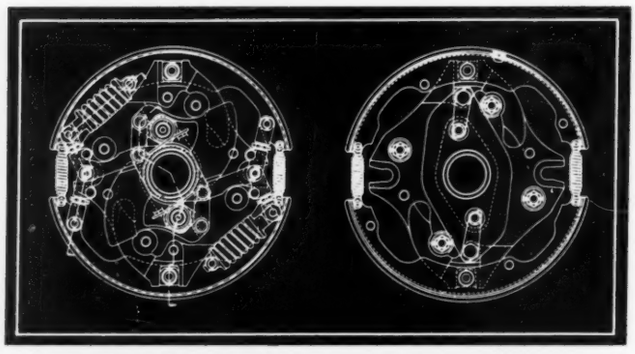


Fig. 5—Centrifugal weights and springs which operate automatic clutch may be seen in this drawing

clutch is 16 inches in diameter and 3¼ inches wide.

Since there is a slip period between 400 and 800 RPM when accelerating, excessive slipping is prevented by pushing the accelerator down as far as it will go. The clutch remains fully engaged until the engine speeds drops to 400 RPM after which it snaps out of engagement. This is because the pressure spring is locked in by the toggle which is nearly straight, preventing the reaction of the spring reaching the centrifugal weights which are provided with torsion springs surrounding their hubs for their return. The pressure springs are each pre-loaded to approximately 1400 pounds in the "off" position and the anchor end is pinned to the shoe. The roller at the toggle end creeps on the inner face of the shoe and is able to compensate for lining wear. Torque to the shoe is transferred from the engine flywheel spider plate through a centrally located trunnion block. The toggles serve no function except to expand the shoes into the engaging position and to augment the force of the pressure springs with the force of the weights during this period. The weight travel is limited by a positive stop. The secondary toggle pin has a head extension on which is mounted a sleeve roller centered in a radial slot of the spider. The shoes are thus centralized and a definite clearance relationship between the lining and the drum is maintained. The retraction springs help in this function.

Three-speed transmission provides ratios of 3.25-1, 1.56-1 and 1-1 in forward speeds and 3-1 in reverse. At the left end of *Fig.* 4 is shown the clutch drum which drives the first speed shaft through an overrunning clutch adjacent to its hub. The second speed shaft is tubular and surrounds the first speed shaft. The gears at each end of these shafts mesh with three sets of planetary gear clusters. When the planetary housing is stationary, drive is conveyed from the wide faced gear of the cluster units to the main drive shaft and thence by bevel gearing to the rear axle.

Because of the constant-mesh relationship of the first and second speed sun gears, it is apparent that while the first speed reduction is effective, the second speed sun gear is being driven by the cluster units. At the left end of the second speed shaft is a centrifugal governor which will, as the vehicle speed increases, overcome the force of two compression springs and attempt to move the second speed clutch member to the left through the intermediary of a coil spring. The mating clutch member is secured to the main clutch drum. The faces of the lugs on the driven clutch member are relieved at the trailing edge and the drive lugs are relieved at the leading edge, causing the lugs to slip as the governor weights attempt to effect engagement. Since the clutch drum revolves faster than the driven clutch member, the former overrides the latter. When the accelerator is released to effect the gear change into second, the clutch members go into full engagement as the main drum decelerates to a point where the speeds of the driving and driven clutch members synchronize. Power is now conveyed from the main clutch drum directly through the second speed clutch on the second speed tubular shaft and then through the second speed gearing of the planetary system. While in second gear, the planet cluster units drive the first speed sun gear and its shaft faster than the main clutch drum. The overrunning clutch therein permits this "over-run."

Housing Does Not Revolve

It will be noted that the planet housing does not revolve during first and second speeds, being restrained by the reaction of the clutch member. Its outer race has the cam contour on its inner face against which the rollers abut. The outside is provided with gear teeth, forming the male member of an internal-external gear clutch.

During forward drive the non-revolving internally-toothed clutch member engages the reaction clutch cam gear when it is shifted to the right. This clutch member is supported on a carrier plate, sandwiched between the front and rear sections of the transmission case. It also contains a large ball bearing, supporting the front end of the planetary case. The clutch member is mounted on and guided by an externally-toothed hub portion of the carrier plate and is able to engage the reaction clutch cam gear by

(*Continued on Page* 89)

Designers Take Part in Forum on Electrification

ACTIVE participation in the formal program on the part of engineers of the machine tool industry characterized the second machine tool electrification forum held at the Westinghouse plant in East Pittsburgh, April 19-22. Of twenty papers presented, six were by representatives of machine tool builders while two others were by representatives of the steel and automobile industries.

Planned primarily to bring about a mutually advantageous meeting of minds between the designers of electrical equipment for metalworking machinery and designers of the machinery on which this equipment is used to an increasingly large extent, the forum obviously is accomplishing its purpose. That was plainly indicated by the fact that certain improved equipment —pushbutton stations in particular—shows unmistakable signs of having been influenced by facts brought out during the first forum about a year ago. Judging by the still greater frankness in discussion this year, this inspired improvement in design is destined to go considerably further.

The forum was conducted as a series of engineering meetings, each one representing to a considerable extent some particular phase of electrification. For instance, the first formal session was devoted to motors and including the following papers: Development of the Fan-Cooled Motor, by J. L. Brown; Theory and Practice in Dynamic Balance, by J. G. Baker and M. S. Hancock, and its Practice in the Machine Tool Industry, by F. L. Chapman (Gisholt); Electrical Braking of Alternating Current Motors, by W. I. Bendz; and Motors for Special Applications by R. S. Elberty.

Discussion on the subject of braking was especially lively and many ingenious combinations and modifications of conventional braking practice were brought out by the machine tool men. Their requirements include power to stop almost instantly, to make repeated stops at precisely the same point, and to have braking apparatus which is compact and relatively "foolproof." Here seems to be a fruitful field for design effort, with achievements to date showing high ingenuity on the part both of electrical and mechanical engineers.

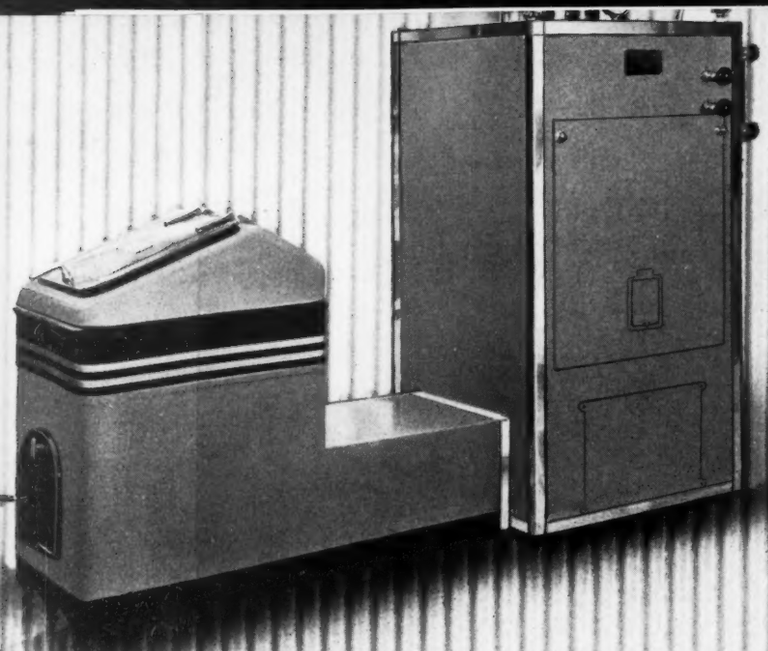
A later session was carried out entirely with speakers from the machine tool industry. The papers were: An Ambidextrous Machine Tool, by H. Earl Morton of the Morton Mfg. Co., presentation being by O. G. Rutemiller; Electrification of Roll Grinding Machines, by W. Trible of Cincinnati Milling Machine Co. and Cincinnati Grinders Inc.; Electrical Equipment for Control of Hydraulic Motions, by E. E. Opel of the National Automatic Tool Co.; Motor-Operated Chucks, by Geo. Highberg of the Cushman Chuck Co.; and Electrical Wiring of Machine Tools, by D. K. Frost who is electrical engineer for both the Mattison Machine Works and the Sundstrand Machine Tool Co.

Mr. Opel stressed the need for "more and better gadgets," his idea being that while motors and simple control units are already well developed, a large variety of secondary units now coming into use in machine tool electrification still present much room for standardization and improvement. Several delegates emphasized the need for rugged and accurate limit switches designed especially for machine tool application.

Prominent engineers of the machinery industry view some of the recent developments in electrification

Mr. Frost urged that the machine designers see to it that proper channels and openings for wiring be designed into frames and beds. He warned against using triple holes for three-wire passages, however, as induction heating of the webs between the holes is set up.

General impressions gained at the forum are that built-in, rather than built-on electrical equipment is in the ascendancy; that machine tools of the future will represent co-operative mechanical and electrical engineering; that with increased use of electrical control will come built-in instrumentation; that accuracy and appearance of electrical equipment has undergone decided improvement; and that "more and better gadgets" for machine tool electrification will be available soon.



Combination of an American Radiator boiler, above, with a Holcomb & Hoke stoker makes an efficient and attractive heating unit. Boiler is trimmed in chromium with heavy enamel finish while stoker is painted in colors to match. Specially hardened screw delivers coal from stoker to fire pot

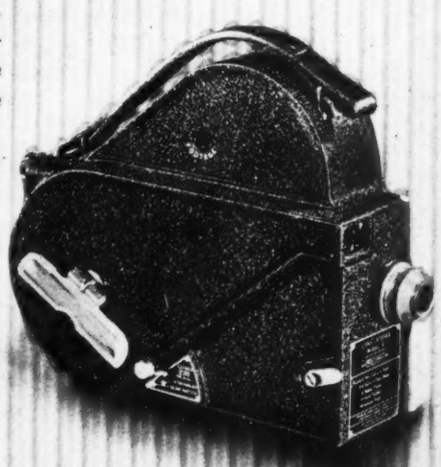
Simple retractable landing gear, electrically controlled, on the Lambert Monocoach airplane, right, weighs less than the average non-retractable type. Two five-cylinder 90-horsepower engines will drive the three-passenger plane at 150 miles per hour

Design Fe
In New M

A Pictorial Presentation of
from the Standpoi

Three rotating plastic cylinders replace the conventional hands in the Lawson clock, above. It is equipped with a synchronous, self-starting motor, and the attractively designed metal case is finished in a bronze hue

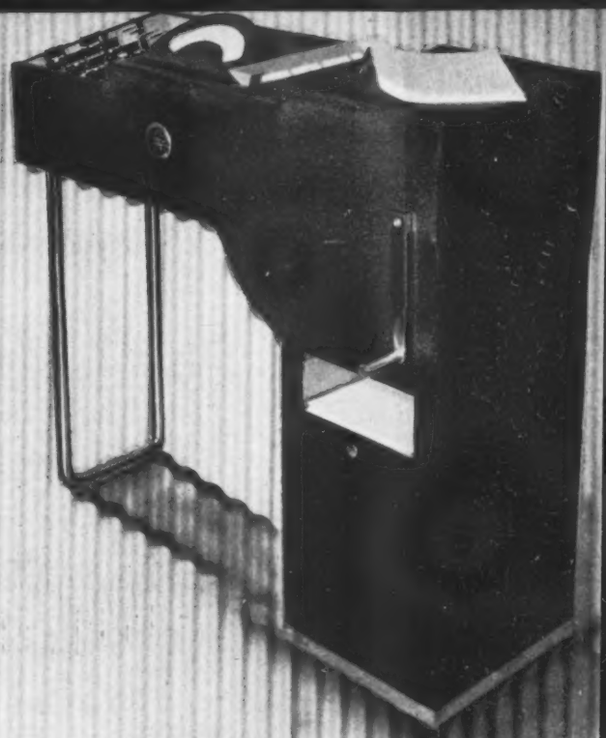
The five cutter head units on the Fay & Egan tenoner, below, are controlled from a built-in pushbutton panel having a start and stop switch for each motor and a master button for the entire machine. Enclosed type motors have air passages for forced ventilation



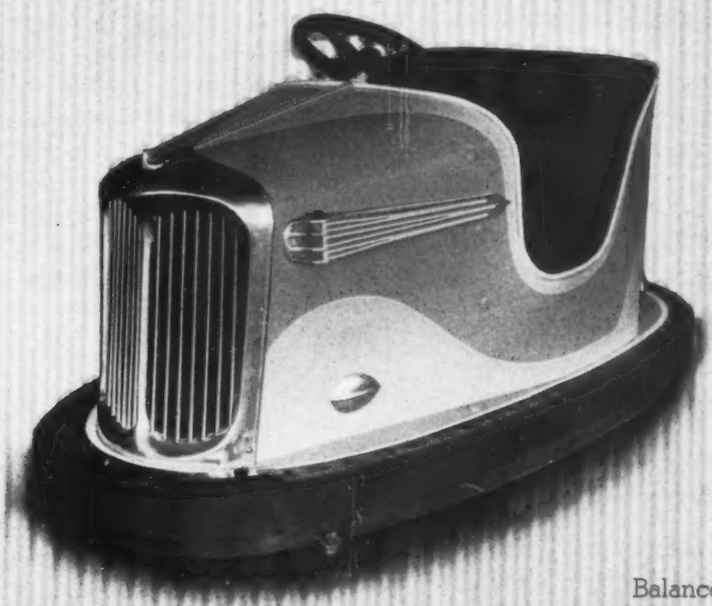
Die-cast aluminum case encloses the small Eastman movie camera, above, which holds 100 feet of film. Quiet spring motor runs at normal speed for half a minute. A film footage indicator enables the operator to keep an exact check on the film used

gn Features
ew Machines

esentation of Recent Machinery
he Standpoint of Design



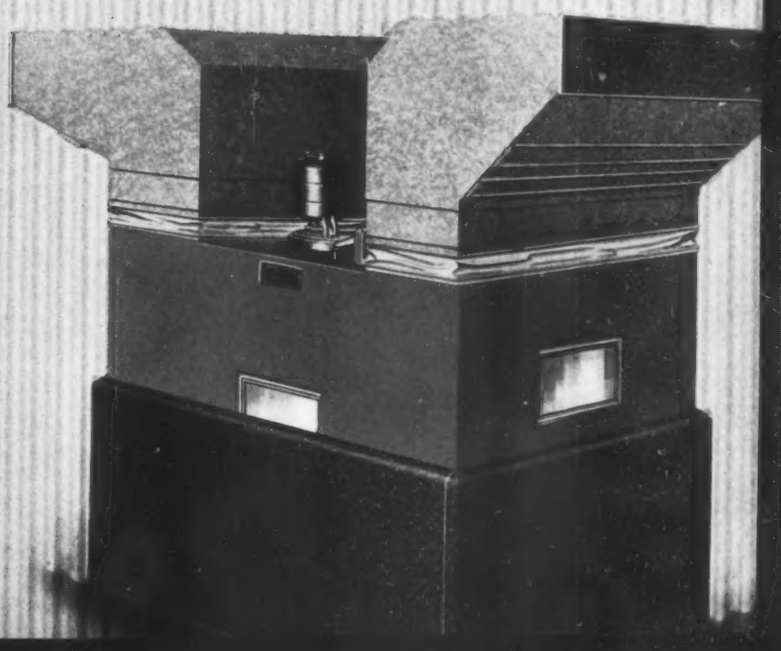
Fitted with a vertical ball-bearing motor driving through a direct-geared, fully enclosed transmission, the Lusse auto skooter, below, possesses the design features of the modern auto. Rubber is used for mounting the rear axle and for a cushion extending around the machine



Designed to grade and average test paper results automatically, the International scoring machine, above, registers on a milliampere dial the percentage of correct answers. Complex electrical and mechanical devices are completely hidden from view in the three-foot cabinet

Balanced on a cushioned rubber base, the die-cast aluminum turbine wheel in the Utica air conditioner, below, comprises the only moving unit in the machine. A belt drive transmits power quietly from the fractional horsepower motor on top of the air conditioner

Only five moving parts, all running in a bath of oil, make up the washing mechanism of the improved Kelvinator washing machine, left. Base is of single-piece construction and fits neatly into the washing tub, porcelain enameled inside and out



New Machines Indicate Design Trends

EXPENSIVE machine parts have not, in many cases, been incorporated into machines because it was cheaper to use inferior products and count on several replacements in the life of the machine. When demands for high-speed production were not as pressing as they are today this system was satisfactory. During a slack period, workers who would otherwise be loafing could make repairs and replacements on a machine and have it ready for operation when work speeded up. Now labor costs are high during a peak or even a slack period. Production today calls for machines running full time with few shutdowns. And so we notice a trend toward supplying the best materials and parts in the original machine. Nickel alloys have displaced steel and iron parts because of their higher strength and resistance to corrosion. An article on another page of this issue describes the use of rubber for covering metal parts to obviate abrasion and corrosion, although coating with rubber is an expensive process.

Machines recently developed in addition to those on the preceding two pages follow:

Air Conditioning

Self-contained air refrigerator and dehumidifier, Pleasantaire Corp., New York.

Construction

Four-wheel scraper, Bucyrus-Erie Co., South Milwaukee, Wis.

Excavators, Buckeye Traction Ditcher Co., Findlay, O.

Hauling scraper, J. D. Adams Co., Indianapolis, Ind.

Dairy

Centrifugal insecticide vaporizer, West Disinfecting Co., Long Island City, N. Y.

Power filler and capper, Specialty Brass Co., Kenosha, Wis.

Cleaning machine for milk cans, Muller Flexible Shaft Co., St. Paul, Minn.

Capping machine, Sealright Co., Fulton, N. Y.

Domestic

Floor polisher, General Electric Co. Appliance and Merchandise Div., Bridgeport, Conn.

Centralized unit for washing and drying dishes, scouring pots, washing clothes, dry cleaning, ironing, etc., Unitor Corp., Detroit.

Drug

Tablet making machine, F. J. Stokes Machine Co., Philadelphia.

Industrial

Recirculating dryers, Electric Air Heater Co., Mishawaka, Ind.

Electric drill, Skilsaw Inc., Chicago.

Copper-oxide plate type rectifiers, Hanson-Van Winkle Munning Co., Matawan, N. J.

Hat monogrammer, Roberts, Cushman & Co. Inc., New York.

Portable polisher of metals, wood, bakelite. etc., Trimson Mfg. Co., Cleveland.

Air-cooled gas booster, Lammert & Mann Co., Chicago.

Multi-stage vacuum cleaner, Spencer Turbine Co., Hartford, Conn.

Heat treating furnace, Chas. A. Hones Inc., Baldwin, N. Y.

Rotary cutter, Ball & Jewell, Brooklyn, N. Y.

Electric metal etcher, William Webster Co. Inc., New York.

Two types milling machines, Brown & Sharpe Mfg. Co., Providence, R. I.

Continuous batch-weighing feeder, Syntron Co., Pittsburgh.

Laboratory

Comparison microscope, George Scherr Co., New York.

Laundry

Handkerchief ironer, Huebsch Mfg. Co., Milwaukee.

Lumber

Skidder and stump puller, Dorsey Bros. Inc., Elba, Ala.

Metalworking

Automatic tube and pipe polishing machine, Acme Mfg. Co., Detroit.

Bench type radial drilling machine, Munding Mfg. Co., Glendale, Calif.

High speed gear chamfering machine, Cimatool Co., Dayton, O.

Lathe for machining crankshafts, Wickes Bros., Saginaw, Mich.

Cutting-off machines, Modern Machine Tool Co., Jackson, Mich.

Office

Electric writing machine, International Business Machines Corp., New York.

Interoffice communicator, Carron Mfg. Co., Chicago.

Port-a-phone, Electronic Devices Inc., Cincinnati.

Payroll typewriter, Burroughs Adding Machine Co., Detroit.

Packaging

Label paster, Diagraph Stencil Machine Corp., St. Louis.

Price tag marker, Wm. A. Force & Co. Inc., New York.

Refrigeration

Hydrocyclonic condenser, General Refrigeration Corp., Beloit, Wis.

Textile

Beam and ball warper, T. C. Entwistle Co., Lowell, Mass.

High speed tenter dryer, Philadelphia Drying Machinery Co., Philadelphia.

Workers "Real" Wages Are Increased through Faster Production by Machines

CHIEF engineers and designers should be elated by the fact that business indexes covering orders for machinery have soared upward for the past year or more. Foundry equipment and machine tools—two basic indexes—are around the 250 mark in comparison with the 100 figure of normal pre-depression years. Other machinery indexes are following suit.

Soon the cry may be raised: "How does this affect the nation's standards of living or the real wages of the workers?" The fact is, as pointed out in a recent bulletin of the Machinery and Allied Products institute, that the purchasing power of wages today stands at 45 per cent above that of 1914. This increase is made possible by greater machine production and resultant efficiency.

Another argument that will be heard concerns current unemployment. Admittedly we still have this problem with us but it is interesting to note that the total percentage of population gainfully employed has increased from census to census during the past hundred years with interruptions only during periods of depression.

It is in the nature of things that depressions and peaks of prosperity recur—just like wars. Economic forces have been proved insufficiently strong to obviate these conditions entirely. The best that can be done therefore is to raise the average standard, taken over the years. This already is being done in those countries that are most progressive and advanced in the application of scientific and engineering skill. The United States leads all other countries in the latter respect and the continued display of ingenuity and forethought in research, development and design will go far toward keeping it well ahead of the field.

• • •

Motors and Machines

ONE of the most pertinent comments concerning the campaign waged by MACHINE DESIGN over the past several years for improved appearance in machinery comes from the representative of a well-known electric motor manufacturer. The claim is made that designers have so rigidly adopted the trend toward building-in machine parts that motors have in many cases been tucked away in insufficiently ventilated sections of machine bases. One result is that temperature rise has been greatly increased and over-powered motors have in consequence become necessary.

Motor manufacturers are to be credited with having recognized the tendency toward improved appearance and with having redesigned their lines accordingly. Therefore, it is not by any means essential in all cases to try to enclose these units. Where, however, the general lines of the machine make enclosure mandatory—and this appears to be increasingly the case—provision should be made for adequate ventilation with resulting efficiency from the drive. Manufacturers of the motors naturally are anxious that the best possible use be made of their products, and a brief consultation with them at the time of incorporation of the motors in the design of a new line of machines will pay ample dividends.

Professional Viewpoints

MACHINE DESIGN WELCOMES LETTERS SUITABLE FOR PUBLICATION

Stroboscope "Stops" Moving Parts

To the Editor:

BAFFLING problems in machine development, ranging from high-speed, valve-spring action to sewing machine shuttles and vibratory motions, need only a stroboscope for rapid solution in many instances. The value of the stroboscope in the diagnosis of a mechanism by causing an apparent "stopping" or "slowing up" of the motion of high-speed rotating or oscillating parts is widely appreciated, but its extensive use is hampered because of the relatively high cost of commercial stroboscopes.

A simple yet effective stroboscope may be built in an hour. Remove the guard and fan blade from a six or eight-inch, universally-wound desk fan. Mount on the shaft a thin black disk with a narrow radial slit cut through its face, far enough from the hub to clear the motor housing. Connect a carbon pile rheostat in the line to control the motor speed and the instrument is ready for use.

To observe the slow speed action, look through the revolving slit and directly at the high speed part to be diagnosed. A relatively high illumination is necessary because of the loss of light through the shutter. For best results the observer should stand in partial shadow. When the shutter speed of the stroboscope has been synchronized with the speed of the mechanism by the rheostat, the action will appear to be "stopped"; when the instrument's speed is changed slightly, an apparent slow motion will be observed.

—A.W.E.
Cleveland Heights, O.

Interviewer's Wait Made Interesting

To the Editor:

IN A recent number of MACHINE DESIGN under "Topics" you mentioned the practice of keeping customers or salesmen waiting or cooling their heels, as it were, in the lobby of a plant. You spoke of the matter of creating goodwill by avoiding this. At our plant we not only put forward every effort to avoid making the customer wait, but endeavor to make any necessary wait so interesting that he is in no hurry to bring about the interview.

We have in our lobby, showcases containing our complete line of clocks and speedometers, sample hall clocks standing at vantage points and in the center of the room a large glass-covered table which contains the various parts of watches, properly tagged and laid out. This gives the visitor an interesting and educational way of spending his "waiting" time and also gives us a chance to advertise our wares. In addition, instead of the traditional hard-backed bench, we use a cushioned bottom and back type which is the acme in comfort.

As a test, when I have been unavoidably detained, I have asked visitors how they enjoyed our display. In almost every case the visitor has asked me to explain some point about our products not quite understandable to him before getting down to his own problem. I think this speaks well for our system, for when one can make a customer or visitor feel that his waiting time was advantageously spent, the goodwill gained by the display seems well worth the effort. It would be interesting to hear the ideas of other readers on this subject.

—CHARLES R. WHITEHOUSE
Waltham, Mass.

Shaft Reversals Control Slide

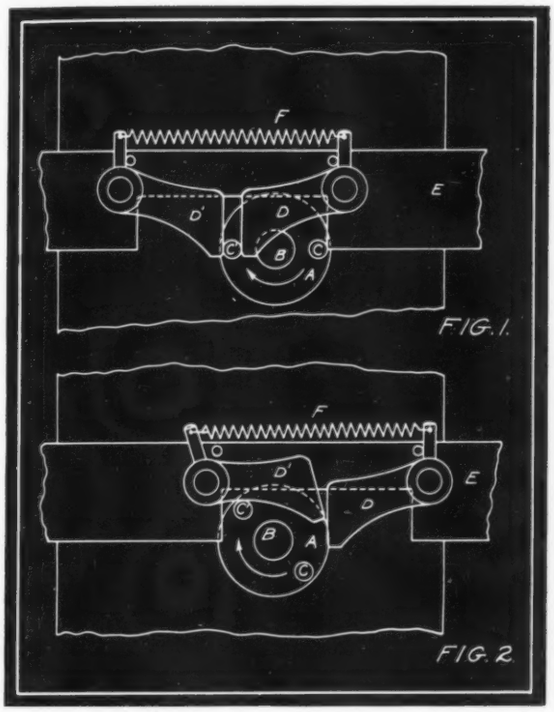
To the Editor:

ON A machine producing a wire product, one part of the mechanism requires frequent reversal of rotation at irregular intervals, as controlled by the operator. As each reversal takes place it is necessary that a slide controlling a tension fixture be moved to the right or left, remaining in position until the next reversal. The sketches show how this is accomplished.

Referring to *Fig.* 1, the shaft *B* carries the disk *A*, which carries the pins *C* and *C'*. The slide *E*, controlling the tension mechanism, carries the pawls *D* and *D'*, which are held in normal position by the spring *F*.

In *Fig.* 1, the shaft *B* has just been reversed to rotate in the direction indicated by the arrow. In this position the pawl *C'* is entering the gap between the pawls *D* and *D'*, the rotation of disk *A* causing the pin

C' to move the slide E to the right into the position shown in *Fig.* 2. Continued rotation of disk A causes no further movement of slide E as, due to the change in the position of the gap between pawls D and D', the pins C and C' are rotating away from, instead of into, the gap. The pins C and C', then contacting the under side of the pawl D', cause the latter to fulcrum



on its stud without transmitting any motion to slide E, as shown in *Fig.* 2. Pawl D' continues to oscillate until the next reversal of rotation of shaft B, when slide E is again moved to the left, and the pawl D is caused to oscillate.

—L. KASPER
Philadelphia

Webs Replace Spokes for Safety

To the Editor:

DESIGNING a machine for safety is one of the most important considerations of the engineer. The modern machine designer cannot afford to ignore any new part or method of construction which will increase the safety of his machine. A recent trend in the design of revolving members which attests to this is the use of web-type rather than spoke-type revolving parts. Spoked pulleys and spoked gears are growing fewer as the years pass, especially for applications that are relatively unprotected.

Not a few men have suffered a broken arm or wrist as a result of reaching through a spoked gear or pulley which starts to move when they least expect it. It is possible that a few designers have noticed while going through shops that a circle has been cut from plywood or from sheet metal to web a spoked pulley to remove the danger of an arm or leg being thrust into it, and from that time have remembered the safety precaution when designing this member.

One happy circumstance with reference to webbed structures is the ease with which they lend themselves to welded fabrication. A circular plate, a piece of heavy pipe, plus a short length of round for a hub soon make up a pulley. Gear fabrication is not far removed from this method of building up a pulley.

One instance where the webbed wheel has been coming into very great favor in recent yars is the bandsaw. The older machines had webbed wheels at the bottom quite often and light spoked wheels at the top, the purpose being to obtain greater flywheel effect at the bottom and maintain a tight blade on the working side. It was noticed, however, that in cases where a bandsaw blade broke, it never became entangled in the lower wheel though often becoming enmeshed with the upper spoked wheel. It was desired to web the top wheel for the added safety, but still not make it so heavy as to produce excessive flywheel effect. The answer, of course, as in many problems where weight is a major consideration, was to web the wheel with aluminum plate.

—JOHN E. HYLER
Peoria, Ill.

Rubber Affords Protection for Machine Parts

(*Concluded from Page* 44)

parts from which it would otherwise be torn by centrifugal force.

As a method of reducing shock and deadening vibration, the application of rubber is well known. Plating the loud speaker housing of an amplifying unit, *Fig.* 6, is something new, however. The covering not only deadens vibration but serves as an efficient electrical insulator and reduces distortion at high pitch.

Machine parts whose function could be improved with rubber covering are almost limitless. So far those that have suffered acutely from abrasion and corrosion have been singled out for this method of protection. In some instances it is, of course, cheaper to replace the metal part than to coat it with rubber. Every indication points, however, to a wider acceptance of rubber covering in the future as costs of the process are being steadily reduced.

Acknowledgment is made to the following for their assistance in the preparation of this article: The Belke Mfg. Co.; The B. F. Goodrich Co.; The Goodyear Tire & Rubber Co., and The du Pont Co.

MEN of MACHINES

AS ENGINEER in charge of the engineering experimental division of the Westinghouse Electric & Mfg. Co. at the South Philadelphia works, R. P. Kroon is now responsible for a wide variety of theoretical and experimental research work which is of vital importance in the development and improvement of this company's products.

Mr. Kroon received his technical education at the Swiss Polytechnicum at Zurich, from which he graduated in 1929. He joined Westinghouse in 1931, entering the design school for mechanical engineers. Upon completion of this course he was assigned to the experimental division where he has specialized on problems of dynamics and strength of materials. He was appointed division engineer on Feb. 1, when J. Ormondroyd resigned to become professor of engineering mechanics at the University of Michigan.

R. P. KROON

• • •

ROBERT F. VOGT, who succeeds the late J. F. Max Patitz as chief consulting engineer of Allis-Chalmers Mfg. Co., Milwaukee, has been associated with this company for thirty years.

Following graduation at the Swiss Polytechnicum at Zurich, where he studied under Dr. A. Stodola, Mr. Vogt began his professional career in the United States in 1903. Four years later he joined Allis-Chalmers as a mechanical engineer. Thereafter he had wide experience in design and development work in various departments and in 1921 was appointed assistant chief consulting engineer.

Mr. Vogt has written a number of technical papers, the more recent ones dealing with helical springs, for which he has developed simple, accurate stress formulas. He is a member of the ASME.

R. F. VOGT

• • •

RETURNING to the engineering department after a year's experience in managing sales of mining and steel mill electrical equipment, H. A. Winne has become general assistant to R. C. Muir, vice president in charge of engineering of the General Electric Co., Schenectady, N. Y.

Mr. Winne, a native of Cherry Valley, N. Y., attended Syracuse university, graduating in 1910 with a degree in electrical engineering. The same year he joined General Electric as a student engineer in the testing department. In 1911 he became head of tests on large motors, generators and synchronous converters and a year later was made assistant general night foreman of the testing department.

In 1916 Mr. Winne was promoted to the power and mining engineering department, now known as the industrial department, and there worked

H. A. WINNE

SUPER PRECISION RUNS IN THE FAMILY

● IN the M-R-C family the methods and standards involved in making Super-Precision Ball Bearings are also applied to produce more uniform standard bearings. M-R-C Super-Precision Ball Bearings are necessarily limited to applications demanding extreme accuracies and speeds . . . but M-R-C Selected and Standard grades all benefit by the methods and standards used for M-R-C Precision and Super-Precision bearings.

Because M-R-C Super-Precision Bearings are the world's finest ball bearings . . . all M-R-C Ball Bearings are better bearings. The M-R-C engineering department is a source of advanced bearing data . . . their suggestions are available without obligation to any ball bearing user.

MARLIN-ROCKWELL CORPORATION

Executive Offices: JAMESTOWN, N. Y.

Factories: JAMESTOWN, N. Y. *and* PLAINVILLE, CONN.

M-R-C *Ball Bearings*

GURNEY ● SRB ● STROM

on problems involved in industrial heating, arc welding and electric furnace equipment. He was transferred to the industrial engineering department's steel mill section in 1922, becoming head of that section in 1930.

Six years later he was made manager of sales of the combined mining and steel mill sections, a position which he occupied until his latest promotion.

♦ ♦ ♦

WAYNE L. COCKRELL has been appointed an instructor in mechanical engineering at Michigan State College, East Lansing, Mich. He graduated in chemical engineering at the University of Cincinnati in 1924, received his master's degree in metallurgy from Carnegie Institute of Technology in 1925, and since then has had broad industrial experience with the Midvale, Crucible Steel, and American Manganese Steel companies.

♦ ♦ ♦

ARCHIE T. COLWELL, director of engineering, Thompson Products Inc., Cleveland, has been elected a vice president of that company. Mr. Colwell is a West Point graduate and has been with Thompson Products since 1922.

♦ ♦ ♦

HYMAN BORNSTEIN, chief chemist and metallurgist of Deere & Co., Moline, Ill., has been nominated for president of the American Foundrymen's Association.

♦ ♦ ♦

ROBERT A. WEINHARDT, formerly assistant chief engineer of the Reo Motor Car Co., has joined the W. M. Chace Co., Detroit, as specialist on thermostatic bimetal applications in the automobile industry.

♦ ♦ ♦

RAYMOND W. YOUNG, assistant engineer, Wright Aeronautical Corp., Paterson, N. J., has been awarded the 1936 Manly Memorial Medal by the Society of Automotive Engineers for his paper on "Aircooled Radial Aircraft Engine Performance Possibilities."

♦ ♦ ♦

ALFRED IDDLES, formerly executive vice president of United Engineers & Constructors Inc., Philadelphia, has joined the engineering department of Babcock & Wilcox Co., New York. He will assist E. G. Bailey, vice president in charge of engineering, and will have charge of application engineering and service work.

* * *

HON. MICHAEL DWYER, minister of mines for Nova Scotia, has been elected president, Canadian Institute of Mining and Metallurgy. Mr. Dwyer, who attained considerable prominence in connection with the rescue work at the Moose River gold mine in Nova Scotia, is a brother of Pat Dwyer, engineering editor of THE FOUNDRY.

* * *

A. E. ROBB has been appointed vice president in charge of engineering and sales of the Jadson Motor Products Co., Bell, Calif., manufacturers of aircraft engine parts. Mr. Robb's appointment followed the recent acquisition of the Jadson company by Thompson Products Inc., Cleveland.

* * *

RICHARD F. BARNES JR. has joined the technical staff of International Nickel Co., New York, as a specialist on metal corrosion problems.

♦ ♦ ♦

WAYNE R. FULLER, formerly technical director of Pratt & Lambert, Inc., Buffalo, has been appointed manager of industrial research for Devoe & Reynolds Co. Inc., Louisville, Ky.

♦ ♦ ♦

ALBERT L. GALUSHA has been appointed chief engineer of the gas equipment division of the Wellman Engineering Co., Cleveland. His headquarters are at the eastern office of the company in New York.

♦ ♦ ♦

EDMUND C. POWERS, who for three years has been a technical writer for the Lincoln Electric Co., Cleveland, has been made assistant secretary of the James F. Lincoln Arc Welding Foundation.

♦ ♦ ♦

R. L. BENSON and E. E. NOFZINGER have been added to the engineering and development department of Gibson Electric Refrigerator Corp. Mr. Benson was formerly connected with both Westinghouse Electric & Mfg. Co., and Frigidaire Corp. Mr. Nofzinger left the employ of Douglas Aircraft Corp. to accept the position with the Gibson company.

♦ ♦ ♦

JAMES T. GOW is a new member of the Battelle Memorial institute staff, and will devote his efforts to metallurgical research, particularly in the fields of heat and corrosion resistant alloys. His position previous to joining the institute was that of research metallurgical engineer with International Nickel Co.

♦ ♦ ♦

WILLIAM J. DURING, who since 1923 has been chief engineer of the Precision Castings Co., Syracuse, N. Y., has been elected vice president and a member of the board of directors of that company.

♦ ♦ ♦

JAMES M. GUY has been promoted from assistant chief engineer to chief engineer of the Erie City Iron Works, Erie, Pa.

♦ ♦ ♦

T. W. KAESTNER has resigned as chief engineer of Prima Mfg. Co., Sidney, O., to become engineer in charge of the laundry machinery department of Crosley Radio Corp., Cincinnati.

♦ ♦ ♦

C. J. DUBY, who for the past six years has been chief engineer of the Warren district of Republic Steel Corp., Cleveland, was named chief engineer of the Youngstown-Warren district. E. H. Koenig, formerly chief en-

(*Concluded on Page* 66)

No announcement of greater importance could be made about DOWMETAL—the lightest known practical metal—than that it is now meeting every requirement of high-speed mass production—including costs.

DOWMETAL has definitely emerged from a specialized position among metals.

To its unique quality of being the lightest of all structural metals—a full third lighter than aluminum, with comparable strength, toughness and durability—is added its demonstrated value in full-fledged, mass production products.

Bell & Howell, producers of motion picture equipment, are among the many users taking advantage of DOWMETAL'S unique lightness.

Manufacturers in aircraft, automotive, machinery, household appliance, and various other fields are incorporating DOWMETAL into their products with ease and advantage.

Where lightness means greater speed—greater pay-load capacity—lower power requirements—DOWMETAL, due to its remarkable lightness, can frequently show sizable gains.

DOWMETAL is available in sheet, plate, sand and die-castings, forgings, standard and special extruded shapes.

Investigate DOWMETAL. Learn if it can aid you in improving your product or process. Let us send you the "DOWMETAL Data Book" which covers this rapidly advancing metal completely—its properties, uses and methods of fabrication. No obligation—just write!

THE DOW CHEMICAL COMPANY
DOWMETAL DIVISION • MIDLAND, MICHIGAN

*DOWMETAL
MAGNESIUM ALLOYS
LIGHTEST OF ALL STRUCTURAL METALS

**Trademark Registered U. S. Patent Office*

Noteworthy Patents

HENRY J. GERDAU of San Francisco has been granted patent No. 2,075,843 covering a pump for fluids which is designed to operate at 600 to 800 revolutions per minute, on installations where high suction or pressure heads are required. A cross section of this pump is shown in *Fig.* 1.

The assembly consists of a housing *A* with inlet at *B* and outlet at *C*. Within the bore of this housing is a rotor, made up of drum *D* and impeller *E*. This impeller is made up of hubs *F* carrying radially extending vanes *G*. Drive shaft *H* to which the impeller is keyed, extends through the housing and runs in bearings in the end plates. These bearings are concentric to the bore and are provided with packing glands.

Drum *D* embodies peripheral wall members *J*, in conjunction with end walls. Instead of forming the drum in one integral structure it is desirable to divide it in two sections *K* and *L*, the peripheral wall sections fitting together. The periphery is interrupted by slot *M*, through which passes one of the vanes, and by elongated slots *N* which accommodate the other two vanes. The vane which passes through at *M* has positive drive connection with the drum by means of accurate block *O* carrying rocking slotted pin *P*. This arrangement allows for a certain amount of turning movement on the part of the impeller.

It is evident that while the vane associated with slot *M* can move outward and inward through slotted pin *P*, a positive drive actually exists there between impeller and drum. Each of the other vanes is associated with segmental members *R*, which are movable in respect to the drum—each of these having a slotted pin like that marked *P*.

Drum *D* is journaled eccentric to bore and impeller by means of sleeves *S* which are journaled into the end plates of the casing. Segmental members *R* are carried by webbs and bearing rings which also are journaled on sleeves *S*, thus preventing the segments from pressing against the inner surfaces of the drum.

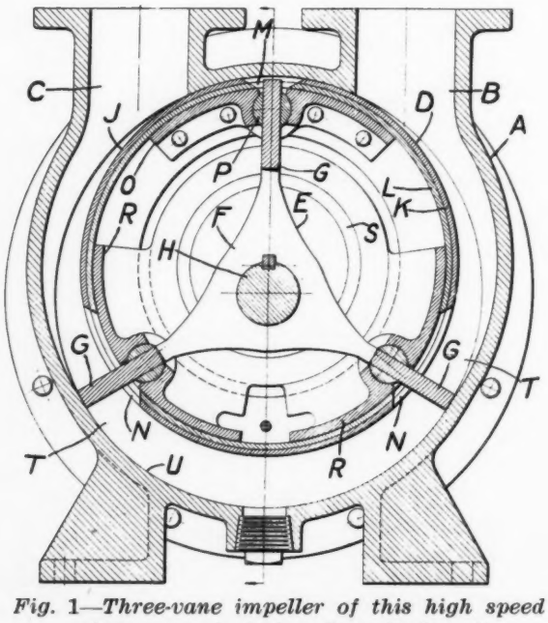


Fig. 1—*Three-vane impeller of this high speed rotary pump is designed as single unit*

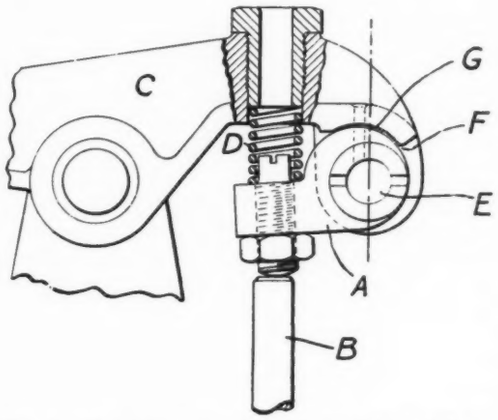


Fig. 2—*Compensator for valve system takes up slack due to warming up of engine*

IMPROVEMENT in the operation of the valves of internal combustion engines is the object of invention by Bror G. Anderson of Syracuse, N. Y. One adaptation of this valve compensating mechanism, which is covered by patent No. 1,994,743, is shown in *Fig.* 2. While this diagram shows it designed into the rocker arm of an overhead valve system, the patent also covers its application to the upwardly lifting valves of an L-head engine.

The clearance in the valve operating mechanism of an internal combustion engine changes as the cylinders

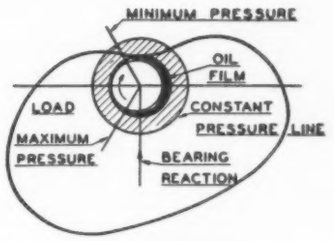
Sleeve BEARING DATA

The LUBRICATION of SLEEVE-TYPE BEARINGS

EFFICIENT bearing performance, of vital importance in every motive unit, is governed to a great extent by the selection of the bearing material, the bearing design and the method of lubrication. By determining these factors, in relation to the operating conditions, we have the basis for the selection of the proper bearing to deliver the desired performance.

In consideration of the lubrication factor, we must determine the following points: Speed, load, viscosity of lubricant, bearing material, clearance, bearing design, nature of the rubbing surfaces, operating temperature and method of feeding and distribution of lubricant.

While the primary purpose of lubrication is to eliminate mechanical friction and to prevent wear and corrosion, no appreciable amount of power can be transmitted on the best of bearing materials without definite lubrication. Heat develops rapidly when the shaft operates in direct contact with the bearing. Heat is also developed beyond the normal radiating capacity if the viscosity of the lubricant is too high in relation to the speed of the shaft.



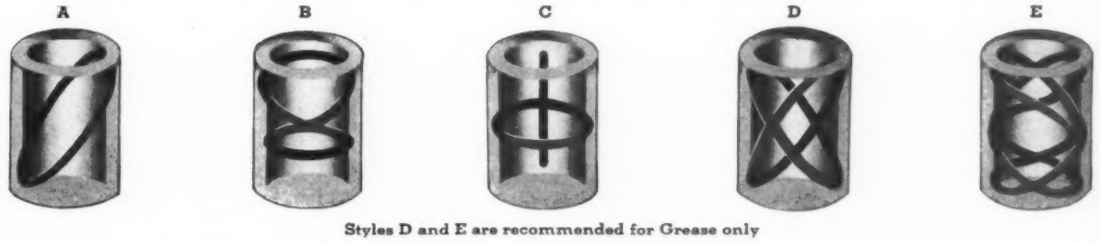
The curve, as shown above, represents the distribution of the calculated values of pressure in relation to the bearing reaction. The load-carrying capacity is governed by the maximum pressure that can be developed under the existing conditions. If the load pressure is down—as illustrated—then the curve indicates that the lowest pressure is practically opposite. Obviously this is the proper place for the intake of the lubricant.

It is a mistaken idea that any type of oil or grease will provide suitable lubrication. The extensive research accomplished by the producers of lubricating materials enables any user of bearings to select the exact type required for his applications. In certain applications it is necessary to provide protection to the lubrication by the use of seals or the design of the bearing. This prevents the lubricant from seeping out to damage material in process.

With the starting of the shaft the frictional resistance is high. As the speed increases, the lubricant under the influence of the moving part plus its adhesive qualities builds up a relatively thick film between the surfaces at the point of nearest approach. The shaft then undergoes a displacement in a direction at right angles to the line of load. The continued speed of the shaft creates a film pressure which increases until an equilibrium is established.

OIL GROOVING

To aid in the proper distribution of the lubricant it is often wise to include oil grooving. The various types shown herewith are easily available in any sleeve bearing. Care should be exercised in the selection of the particular type so that its function will harmonize with the operating conditions. When specifying oil grooving on your orders, refer to the style letter.



Styles D and E are recommended for Grease only

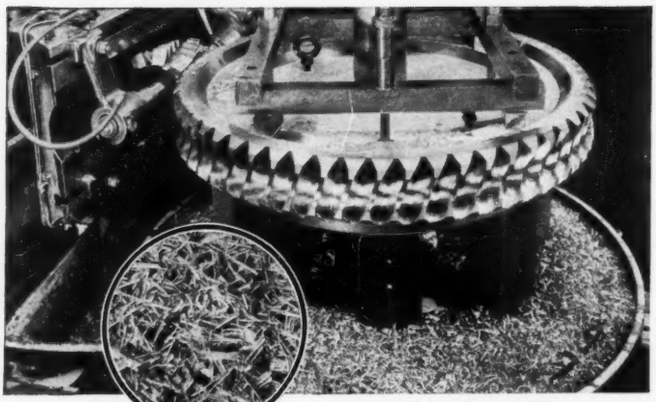
Engineers and Machine Designers

This is but one of a series dealing with the fundamental facts about sleeve-type bearings. You can secure the entire series by writing to the Johnson Bronze Company at the address below.

JOHNSON BRONZE COMPANY
525 SOUTH MILL STREET • NEW CASTLE, PA.

Sleeve BEARING HEADQUARTERS

Not even these BORINGS



Hobbing Cleveland Worm Gear on tangential feed hobbing machine.

Return to the "CLEVELAND" *melt*

★ ★ ★

Design Engineers . . . **Every pound of borings produced while manufacturing Cleveland Worm Gears is sold for scrap. "Cleveland" does no remelting. Cleveland Worm Gears are of *virgin metal.***

★ ★ ★

THE MORE you know about "Clevelands," the greater your confidence in them. Every time you specify "Clevelands" to drive the machinery you design, this good-will increases through your customers' appreciation of what *you* build and what "Cleveland" builds.

Cleveland Worm Gear Drives help stabilize machine performance and thus increase production. They guard against breakdown ("Clevelands" almost never require servicing or parts replacement). They prolong the operating years of the machine—sometimes even outlast it.

Does your "Cleveland" information file contain *enough* live data? It will be a pleasure to supply you with all the latest facts. 'Phone our nearest District Office, or write:

The Cleveland Worm & Gear Company, 3275 East 80th Street, Cleveland, Ohio.

Affiliate: The Farval Corporation, Cleveland, Manufacturers of Centralized Systems of Lubrication

CLEVELAND WORM GEAR *Speed Reducers*

elongate when the engine heats up in action. Therefore, it is desirable that means be provided automatically to take up this increasing clearance, thereby preventing undue tappet noise. This invention takes care of the situation by introducing between tappet and valve a member *A* having wedging or rolling action in a direction at an angle to the direction of movement of tappet *B* and rocker *C*.

Spring *D*, which is much lighter than the main valve spring (not shown) serves to keep the tappet firmly in contact with its operating cam at all times. As soon as the cam begins to lift tappet *B*, spring *D* begins to compress, allowing member *A* to roll on pin *E*.

As is clearly shown in the drawing, surface *F* of member *A* is eccentric to the pin *E*, while surface *G* of the rocker is so shaped that surface *F* of the compensator "cams" or pinches firmly against it after a small amount of free rolling action. Thereupon compensator *A* and rocker *C* become in effect a solid member which then functions as the ordinary unit-type rocker. As the valve operating cam passes its high point, the action is reversed, the compensator finally rolling away from its firm contact with the rocker—this under the influence of spring *D*.

PATENT No. 2,074,328, granted to George H. Fraser of Brooklyn, N. Y., covers a unique application of bearing balls in connection with a driving mechanism.

As shown in *Fig.* 3, the balls—instead of being mounted in rigid retainers—are embodied in flexible belts. In the illustration two of these flexible antifriction belts are indicated by *A* and *B*. In this transmission system *C* is a drive shaft, *D* a spur gear drive pinion keyed thereto, *E* a spur gear driven pinion, *F* a driven shaft keyed to the driven pinion, and *G* an oil reservoir which forms the casing for these parts.

The driving faces of gears *D* and *E* are spaced apart, the teeth being relatively small and the cavities between

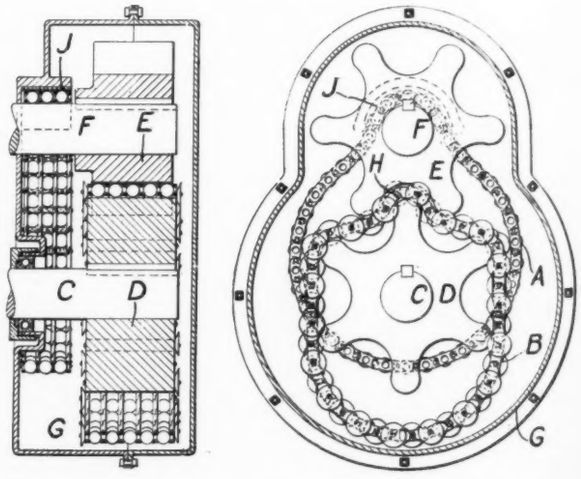
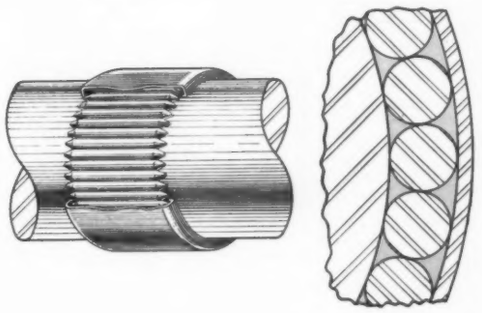


Fig. 3—Chain belts containing bearing balls reduce friction in geared transmission

This new bearing is

Simply and Efficiently Lubricated



Section showing effective lubrication

UNIQUE DESIGN PROVIDES CONTINUOUS ROTATION ON LUBRICANT WITH MINIMUM OF SERVICE ATTENTION. THE IDEAL BEARING SHOULD INSURE A FLUID FILM

THE effective lubrication of any bearing is necessary to economical, satisfactory operation.

Yet the very principle of the new Torrington Needle Bearing insures a lubricating action that is almost incredible in its efficiency. As illustrated above, the outer retaining shell which encloses the needle rollers provides a natural reservoir for the lubricant. Thus, in operation, these needle rolls are continuously revolving in an oil or grease bath and are constantly supplied with a fresh film of lubricant—insuring rotation of all moving members on a fluid film.

The design of the Torrington Needle Bearing, with a clearance of .0025" between the turned-in lip of the shell and the shaft, provides an effective seal. The lubricant is retained and will last for a long time.

Selecting the Lubricant

In cases of low speeds and light loads, a bearing once packed with grease will last for the life of the unit without further attention.

For most applications where the load is below the rated load and the speed under 3,000 R.P.M., grease will give best results. A grease cup or pressure system may be used.

Oil is recommended for speeds in excess of 3,000 R.P.M. A sight feed or constant level may be employed and for extremely heavy loads a circulating system will give best results. Oil is also recommended for temperatures over 250° F. and below 32° F.

These recommendations are based on practical experience with the Needle Bearing which has been subjected to continuous testing and experiment under the direction of Torrington engineers for the past three years.

During this time much information of value has been accumulated on its merits, advantages and applications.

Manufacturers interested in the possibilities of the Torrington Needle Bearing for use on their products are invited to investigate the results obtained in actual installations. Some of them are remarkable.

•

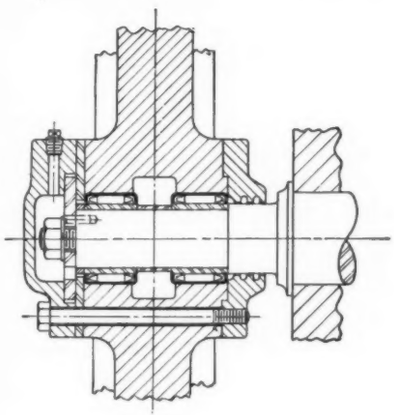
FEATURES OF THE TORRINGTON NEEDLE BEARING

Small Size — **Ease of Installation**
Efficient Lubrication — **Low Cost**
High Radial Load Capacity

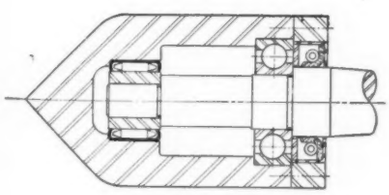
Further information and data on the new Torrington Needle Bearing, the types and sizes available for immediate shipment from stock, etc., available on request. Write for *Catalog No. 9*

•

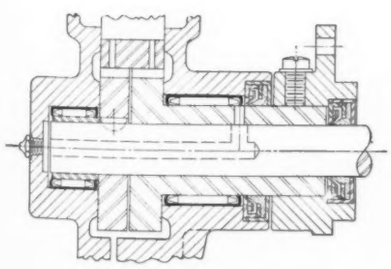
The Torrington Company
ESTABLISHED 1866
Torrington, Conn., U.S.A.
Branch Offices in all Principal Cities



TRUCK WHEEL



TAIL STOCK CENTER

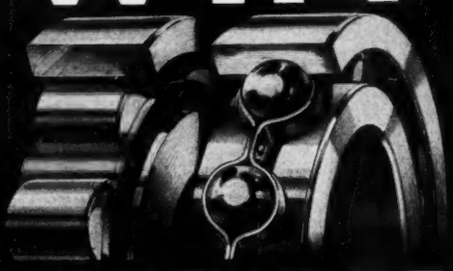


SPEED REDUCER

Representative Installations of Torrington Needle Bearings show the value of efficient lubrication for high loads and speeds.

TORRINGTON
NEEDLE BEARING

TWIN PRECISION



IN the past 20-odd years many standards have become flexible, and quality has—in many cases—become a variable thing . . . But throughout this period NORMA-HOFFMANN Precision Bearings have been consistently made to the highest standard of excellence . . . They continue to be the choice of those who measure value by service rendered, and who seek the lowest cost per bearing per year of useful life . . . *Write for the Catalog. Let our engineers work with you. . . . . .*

"NORMA-HOFFMANN"
PRECISION BEARINGS
BALL, ROLLER AND THRUST
NORMA-HOFFMANN BEARINGS CORPORATION,
STAMFORD, CONN., U. S. A.

them large. This provides a sinuous space *H* for accommodation of the belt *B*. This belt is long enough so that it passes down to the bottom of the oil reservoir, thereby constantly picking up lubricant.

The other belt, marked *A*, provides the antifriction effect and also the lubricant in a semi-circular bearing *J* in which the driven shaft runs.

A RECENTLY issued patent, covering an invention by the late John S. Barnes, identified by No. 2,030,562 and assigned to W. F. and John Barnes Co., Rockford, Ill., has to do with a machine for accurate cutting and chamfering of pipe and tubing.

One of the most interesting features of this machine, the patent on which machine embodies a large number of claims, is the radial multiple cut-off tool arrangement shown in *Fig.* 4. Due to the weight and bulk of the pipeline tubing and its lack of absolute straightness, it has been found impractical to rotate it. Therefore the tubing is accurately centered and clamped in position against rotation and the cutting tools are made to revolve around it, at the same time feeding in radially.

Drive to the revolving drum *A* carrying the tool holders is from motor pinion *B* through large gear *C*, to pick-off gears *D* and *E*, thence through gears *F* and *G* to ring gear *H* on the periphery of the drum. The tools are fed by hydraulic means through the action of piston rods *J* on which teeth have been cut at an angle, these meshing with similar angular teeth on radial slides *K*. As the toothed piston rods move in and out, the cam action on the slanting rack teeth on the slides impart radial motion to the slides.

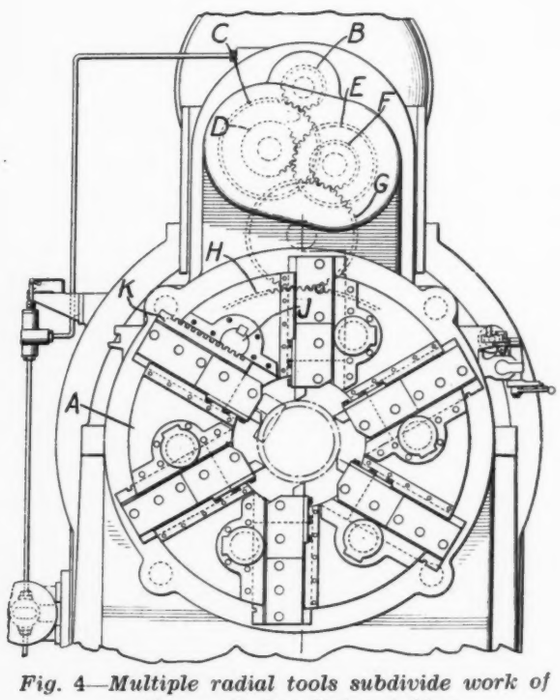
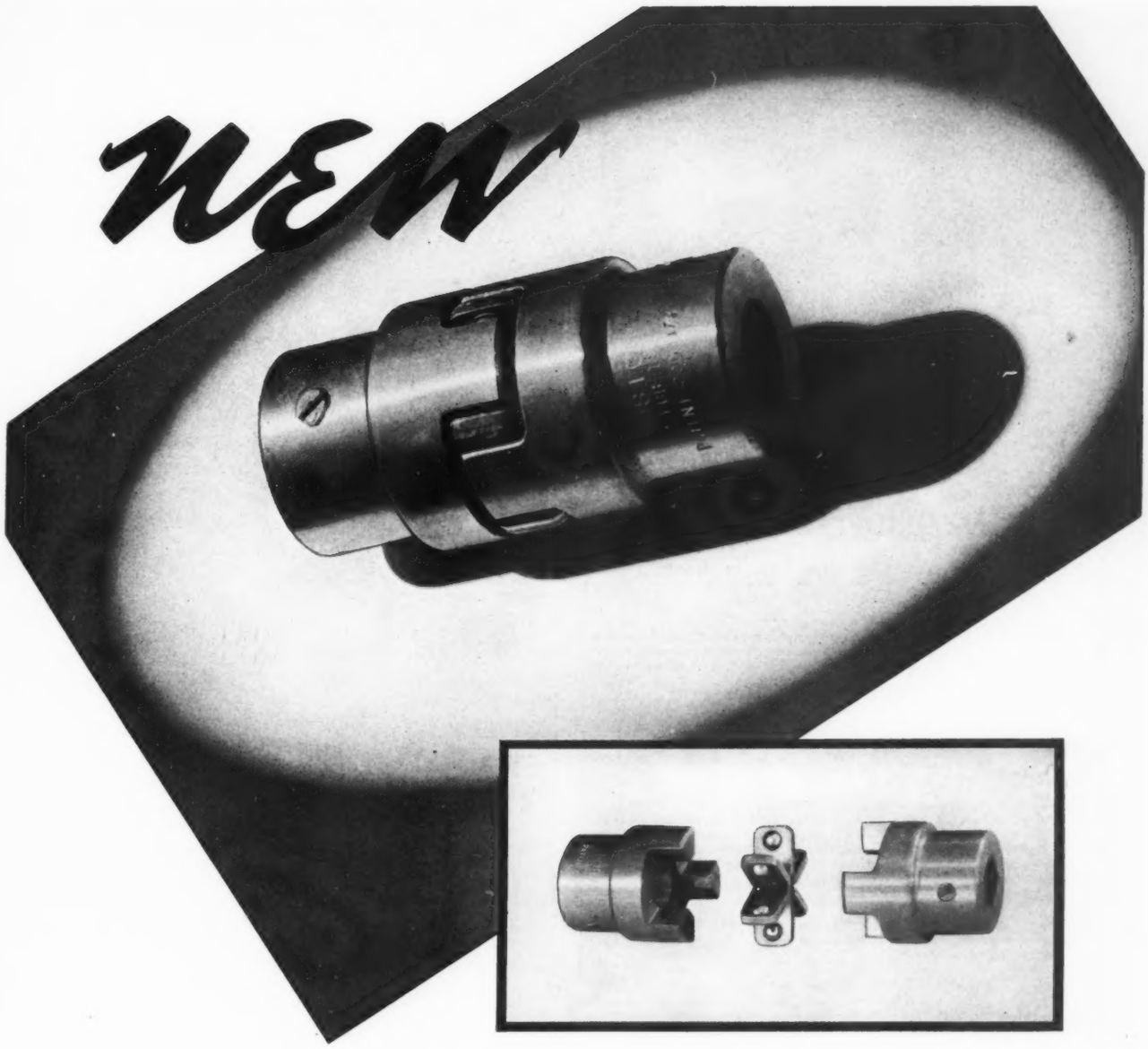


Fig. 4—*Multiple radial tools subdivide work of cutting and chamfering tubing*



THIS NEW Boston Ball Bearing Type

Flexible Coupling is equipped with an insert having hardened and ground balls, similar to those used in ball bearings. When operating, these balls come in contact with hardened and ground jaw surfaces. The greater flexibility of this coupling over the ordinary jaw coupling removes the strain between motor and machine and permits unrestricted end play of motor shaft.

FOR COMPLETE INFORMATION ASK US FOR FOLDER No. 7-36

BOSTON GEAR WORKS, INC.
NORTH QUINCY, MASS.

Reasons Why
Wagner Motors are Preferred

1 ***They are reliable.*** All motor parts and completed motors are carefully tested to meet exacting specifications according to the highest electric motor standards—an assurance to users that Wagner motors are reliable, free from defects and will last a good long time if properly used.

2 ***They are economical.*** Actual tests show that Wagner motors consume very little electric current, do not require much care, and operate smoothly and easily under all types of load conditions.

3 ***They will give satisfactory service.*** Wagner motors of today are the result of constant improvement in their mechanical design and efficiency, gained by 45 years of experience in building and designing motors for industry and the home. These years of experience have enabled Wagner's engineers to determine the characteristics of motors that are best for satisfactory service.

4 ***They can stand rough treatment.*** Wagner motors have rolled-steel frames—strong, rigid—will not get out of alignment—unbreakable.

5 ***They require very little attention.*** The life of motors depends upon the conditions of operation to which they are subjected and the care they receive. Wagner motors are so constructed that wear between moving parts is reduced to a minimum. In addition, Wagner motors are equipped with large oil wells and have special lubrication systems so that only periodic oiling is necessary.

6 ***They are well-designed.*** Due to precision of manufacture, careful selection of materials and parts, and intelligent engineering, Wagner Motors have all the features that contribute to efficiency, and yet are unusually compact in design.

7 ***Convenient service facilities.*** Wagner maintains 25 branch offices, warehouses, and service stations in all parts of the country. Each branch carries a complete stock of parts available for immediate shipment. Thus, when there's trouble with any type of motor, Wagner can give better and quicker service.

The above are just a few of the many reasons why Wagner motors are preferred. Many motor buyers prefer Wagner motors because they know that the Wagner line is so diversified in types and ratings that they can get, without special designing, exactly the right motor for their job. Others prefer Wagner motors because they like the cooperation and helpful assistance the Wagner sales-engineers give them when solving their power-drive problems.

When considering your next motor application or installation problem, avail yourself of Wagner's service. Wagner engineers will be glad to work with you and help you select the correct motor for your job. Descriptive literature will be sent upon request.

MS137-IJ

Wagner Electric Corporation
6400 Plymouth Avenue, Saint Louis, U.S.A.

MEN OF MACHINES

(*Concluded from Page* 58)

gineer of the Youngstown district, has resigned. Mr. Duby successively served as manager of the Youngstown fabricating plant; chief draftsman, Trumbull Steel Co., Warren, O., assistant chief engineer, and chief engineer.

Obituaries

DR. ALFRED D. FLINN, director of the Engineering Foundation and long a leader in organized engineering, died recently at Scarsdale, N. Y., following a prolonged illness.

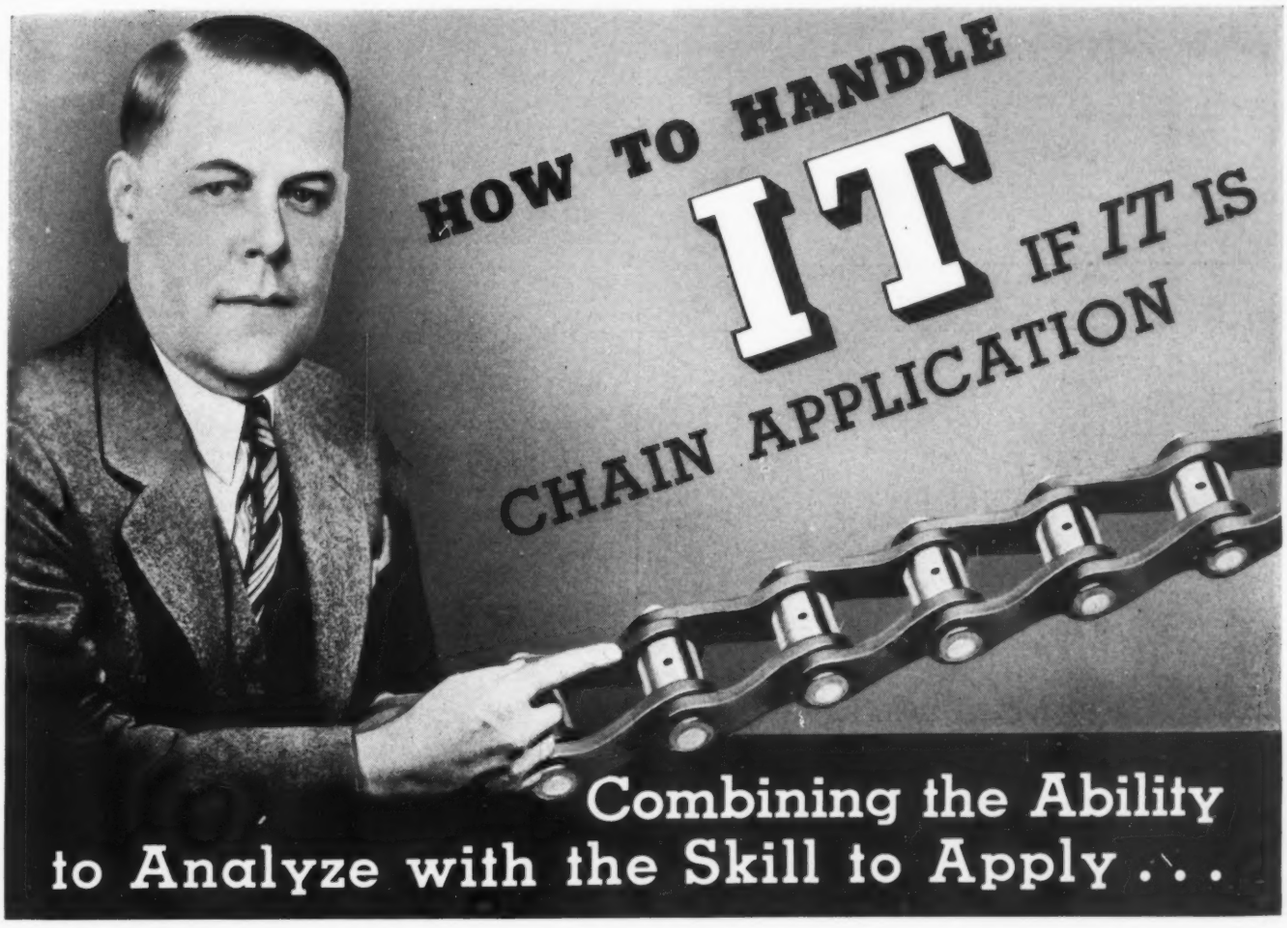
Dr. Flinn, who was born in New Berlin, Pa., in 1869, graduated from Worcester Polytechnic institute in 1893 and did post graduate work at the Massachusetts Institute of Technology. His first work after leaving college was with the Waterworks division of the City Engineer's office in Boston, testing fire fighting apparatus, pumping engines and boilers. From 1895 to 1902 he was an assistant engineer with the Massachusetts Metropolitan Water Works.

After serving for two years as editor of *"Engineering Record,"* Dr. Flinn became general inspector for the Croton Aqueduct commissioners, in charge of the New York office. In 1905 he became associated with the Board of Water Supply of the city of New York, for which he was on a number of occasions acting chief engineer.

In January, 1918, Dr. Flinn was named secretary of the United Engineering Society, which was later succeeded by the Engineering Foundation, of which he became director in 1922.

◆ ◆ ◆

JOHN H. BARR formerly professor of machine design and trustee of Cornell university, died recently at the age of 75. Mr. Barr was the author of many technical papers, a textbook on kinematics, "Notes on Machine Design," and with Dexter S. Kimball, of "Elements for Machine Design." He spent many years in engineering typewriter developments and held over 60 American patents for improvements in typewriter design.



● A heavy machinery manufacturer, when designing a final drive selected a roller chain with a 120,000 lb. ultimate strength. This seemed to him to be the proper chain to combine with the transmission.

On analysis of the problem, however, the Rex Engineers showed that a Rex Chain, having 180,000 lb. ultimate strength, made of special alloy steels, was necessary to handle the power load—and without over-chaining.

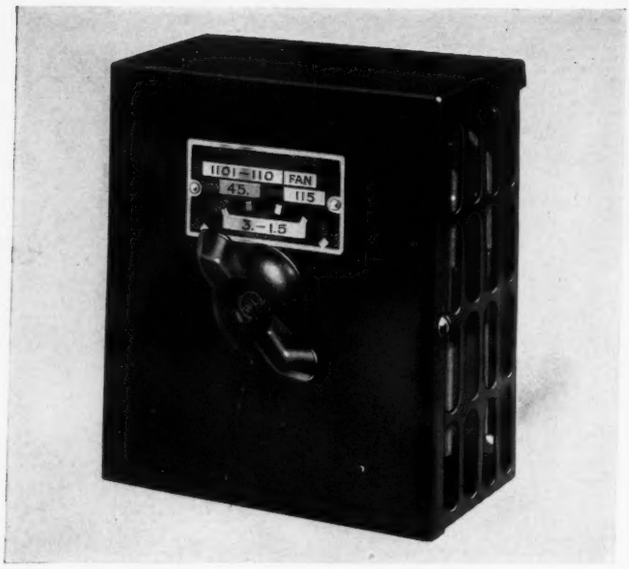
It was decided to make trial units on the latter basis and send them into the field. These have proved to be completely satisfactory. The Rex Engineers' recommendation became the standard specification.

A major part of the function of the Rex Chain Engineers working with your designers and engineers is in the analysis of chain drive problems. Their wide experience enables them to apply chains that meet field conditions.

A brief, new folder tells why Rex Chabelco provides a new type of service on many jobs. Send today for your copy.

CHAIN BELT COMPANY
1643 West Bruce Street
Milwaukee, Wisconsin

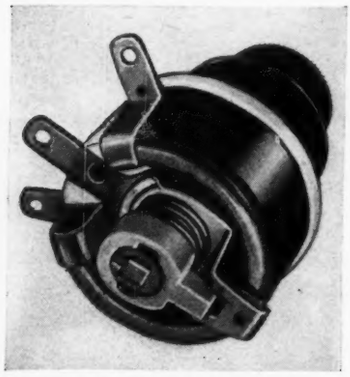
REX
CHAIN BELT COMPANY
of MILWAUKEE
Drive and Conveyor Chains



THIS SPEED REGULATOR

is compact and stays cool

The well planned arrangement permits circulation of air around resistance elements to disperse the generated heat. The Ward Leonard Speed Regulator, therefore, in spite of its compact design, will operate continuously at lowest speed without overheating. It is the ideal control for fan and machine duty, especially where it must be built into the equipment.



The Vitrohm Ring Type Rheostat is designed for control of currents where a compact power rheostat is required to provide a fine continuous adjustment.

Bulletin No. 1101
Describes the Ward Leonard Speed Regulator with ventilated enclosures. 1/20 to 1/3 H.P.

Bulletin No. 1102
Describes the Ward Leonard Speed Regulator Totally Enclosed Types. 1/20 to 1/3 H.P.

Bulletin No. 1105
Describes the Ward Leonard Ring Type Rheostat in 1½", 2¼", 3" & 4" diameters for 30, 50, 100 & 150 watts.

WARD LEONARD

RELAYS • RESISTORS • RHEOSTATS

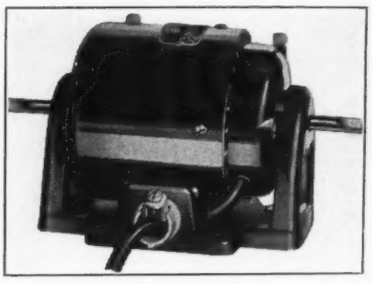
WARD LEONARD ELECTRIC CO.
46 South Street, Mount Vernon, N. Y.

Please send me bulletin No. .....
Name .....
Firm .....
Address .....
City ..... *State* .....

NEW Materials and Parts

Motor Line Is Announced

MOTORS suited for use with air conditioning, refrigerator, unit heater or blower equipment constitute a new line introduced recently by the A. G. Redmond Co., Flint, Mich. The line is represented by three types of motors, similar in design but unlike in their provision for mounting. The motors are supplied with sturdy die-cast housings having an external ventilating shell and an enclosed cooling fan. Their rigid sleeve bearings are of a self-lubricating type, provided with large capacity oil reservoirs. Motors may be furnished for operation in both vertical and horizontal positions. Standard motors in this line are from 1/125 to 1/25 horsepower, operate on 110 or 220 volts, 50 or 60-cycle frequency with a speed of from 1500 to 1650 RPM.



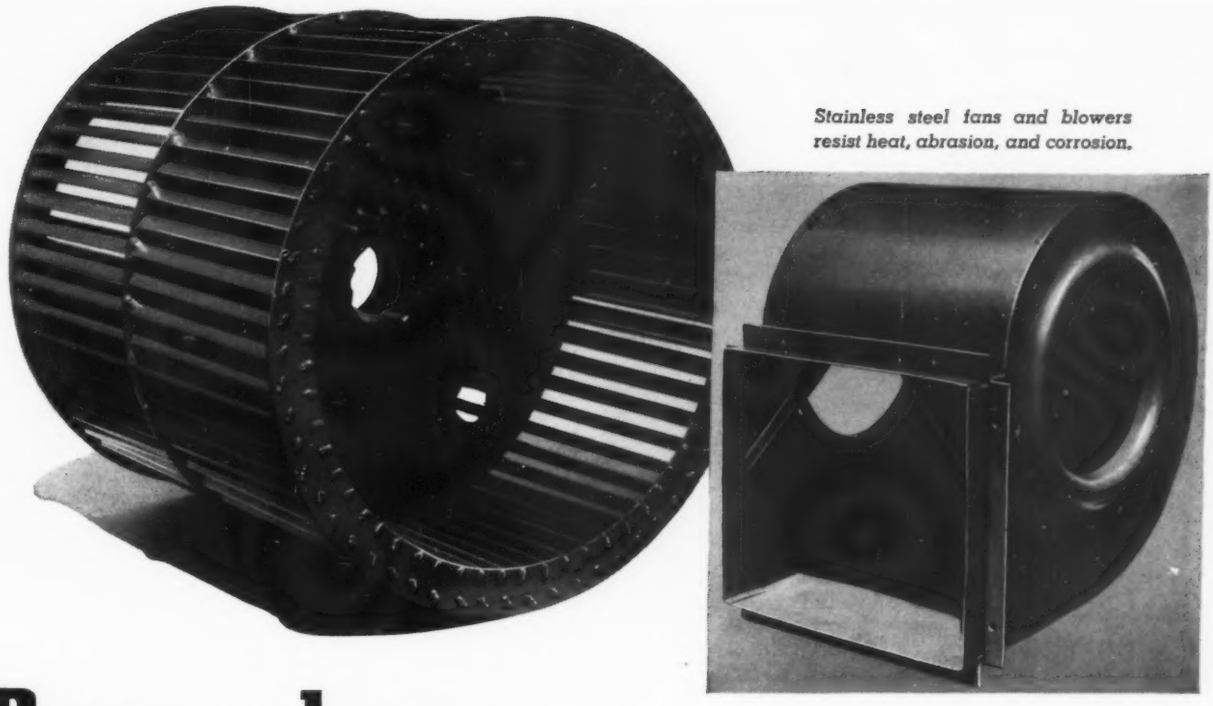
Die-cast housing with external ventilating shell makes this motor suited for many applications

---

Magnetic Clutch Is Improved

RECOMMENDED for universal dry or wet application, a new type magnetic clutch, style E, has been announced by the Stearns Magnetic Mfg. Co., Milwaukee, Wis. Automatic self-alignment at all times is a distinctive feature of the new clutch. The cage floats around the friction elements and thereby

Floating cage around friction elements assures alignment at all times



Stainless steel fans and blowers resist heat, abrasion, and corrosion.

Better..because *it's Stainless Steel*

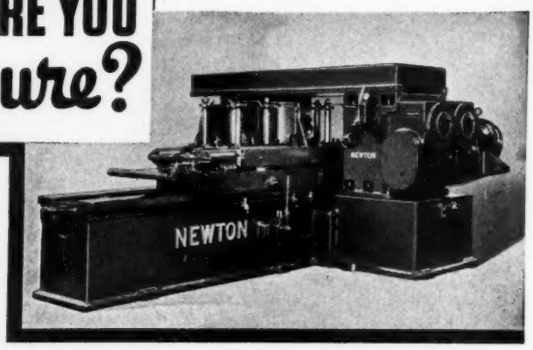
THIS blower is *better because it's stainless steel!* . . . Stainless steel resists heat and abrasion and thus is particularly advantageous in blowers that draw off exhaust gases from furnaces where temperatures are high and where pulverized fuel and hot ash constantly strike the blades. Also, stainless steel is an ideal material for exhaust fans in vents over pickling vats and in other chemical processes, because it resists hot, corrosive acid fumes and gases. If the steel is of the chromium-nickel type for service at 700-1500 degrees Fahrenheit, it should contain columbium to prevent intergranular corrosion.

Efficient, trouble-free performance and long life may be confidently expected from products made of stainless steel. In thousands of applications, stainless steel makes possible a better product and does a better job. It will pay you to investigate the many possibilities of stainless steel.

Electromet does not make stainless steel, but for over thirty years has produced the ferro-alloys that go into the making of stainless and other alloy steels. This experience can assist you in selecting the best available alloy steel for your particular application. Write for further information.

ELECTRO METALLURGICAL COMPANY
Unit of Union Carbide and Carbon Corporation
UCC
CARBIDE & CARBON BUILDING **Electromet** 30 EAST 42nd ST., NEW YORK, N. Y.
Ferro-Alloys & Metals

ARE YOU *sure?*



PROVISION by the Design Engineer for the proper lubrication of *all* bearings eliminates costly guesswork by the owner—your customer. Hand lubrication may mean that the oiler is taking only the bearings he can see. Frequently, however, many of the most important ones cannot be seen at all, and may be missed entirely.

How about the machines *you* design? Are you *sure* every bearing is properly lubricated? Better install Farval and insure continuous production for your customers!

The Farval System is a mechanical method of delivering clean lubricant from a central station under high pressure to a group of bearings, in exact, measured quantities. Operation is constant and positive, regardless of the number of bearings in the system, *and not a bearing is missed.*

Farval Engineers will gladly help you plan the System best adapted to the equipment you design and build. The Farval Corporation, 3265 East 80th Street, Cleveland, Ohio.

Affiliate of The Cleveland Worm & Gear Company, Manufacturers of Automotive and Industrial Worm Gearing.

FARVAL

CENTRALIZED SYSTEM OF LUBRICATION

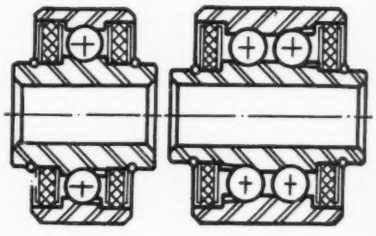
Special Delivery to Every Bearing

eliminates possibility of uneven wear on any part of the unit, giving even engagement over a long period of service. Absence of push rods, by using the floating clutch cage construction, allows greater freedom of action and avoids binding in the friction elements. Another feature is the simplified latch and groove lock design which permits easy adjustment in a few moments without the need of tools. Removal and replacement of linings may be accomplished by spreading the driven hub from the clutch hub which gives sufficient distance to permit insertion of new disks.

Aviation Uses Develop New Bearings

NEW additions to the line of bearings designed primarily for the aviation field, but used by other industries as well, are now offered by Fafnir Bearing Co., New Britain, Conn. The new bearings are of the double felt-seal type and are known as the KF, KF-A and DF series. Both the KF and KF-A are designed with a single row of balls while the DF

Protection against dirt and dust is offered in these bearings with double felt seal

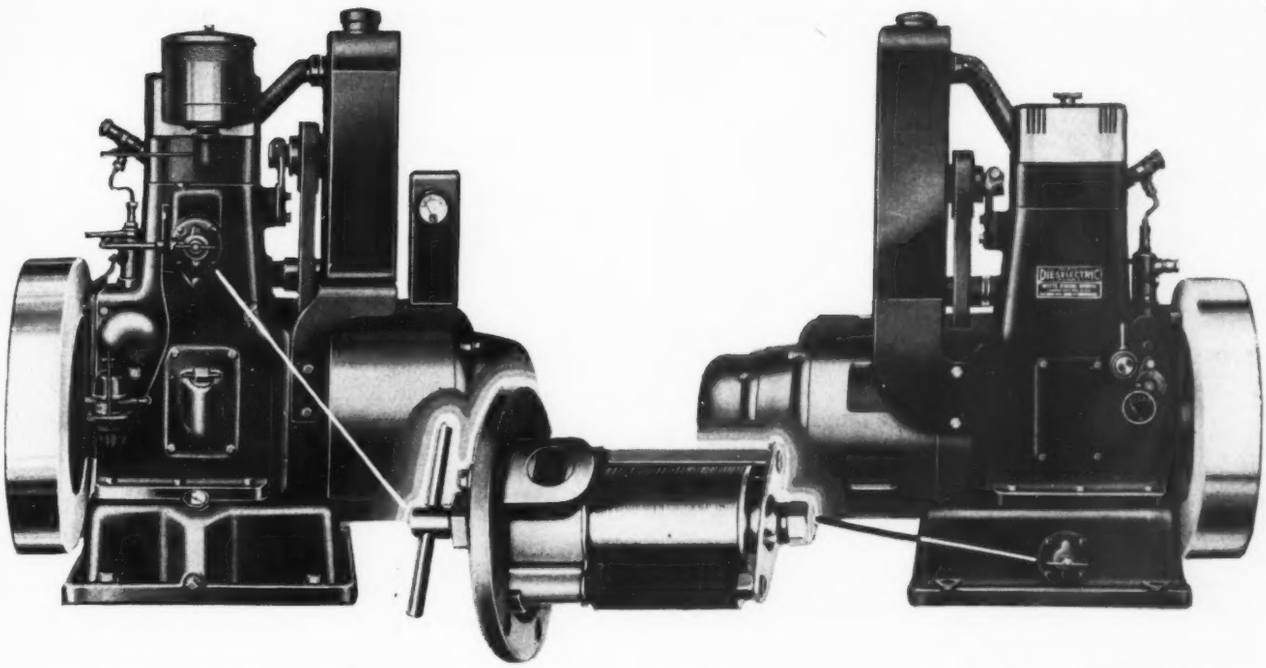


KF DF

makes use of a double row. These bearings, of which the KF-A (single row radial with double metal shields) is an army standard, and the KF, a navy standard, round out a line which conforms to specifications of aircraft engineers for weight, tolerances, dimensions, and radial and thrust capacity.

High Capacity Cells Developed

A NEW line of primary power carbon cells has been introduced by Le Carbone Co., Boonton, N. J., which has unusually high capacity. The cells are of the radically different type introduced several years ago by the Le Carbone Co. and utilize the principle of air depolarization. The new line is designed on the same principle as earlier cells, but in view of their great capacity a liquid electrolyte has been adopted. The electrolyte is solid until water is added when the cell is to be used. As they are thrown away when discharged, there is no expense of maintenance in connection with renewals except connecting up the cells. In addition to the air depolarization principle, the cells work on a new and different feature of regeneration

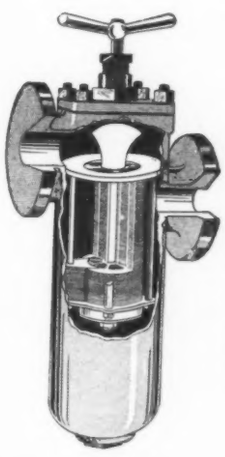


CLEAN OIL *Continuously* ···and the CUNO Filters are integral features of this Diesel Unit

The specialized application of CUNO *Continuously Cleanable* FILTERS to the modern tools of Industry is particularly well defined in the startling, new Witte Vertical Diesel Engines shown here. Witte engineers now offer Diesel power in its smallest, most compact form . . . and, logically enough, both fuel and lubricating oil systems are CUNO equipped. Here, the menace of shut downs and premature wear due to foreign solids which commonly contaminate Diesel fuel and lubricating oils is definitely eliminated. The CUNO Auto-Klean FILTERS which are integral, standard equipment features of these notable new engines offer constant protection. And, these FILTERS are *Continuously Cleanable* while in service without any interruption of flow or power production.

When you set out to incorporate every modern feature of advanced engineering in your machine tools or apparatus, be sure to provide CUNO's *Continuously Cleanable* FILTRATION.

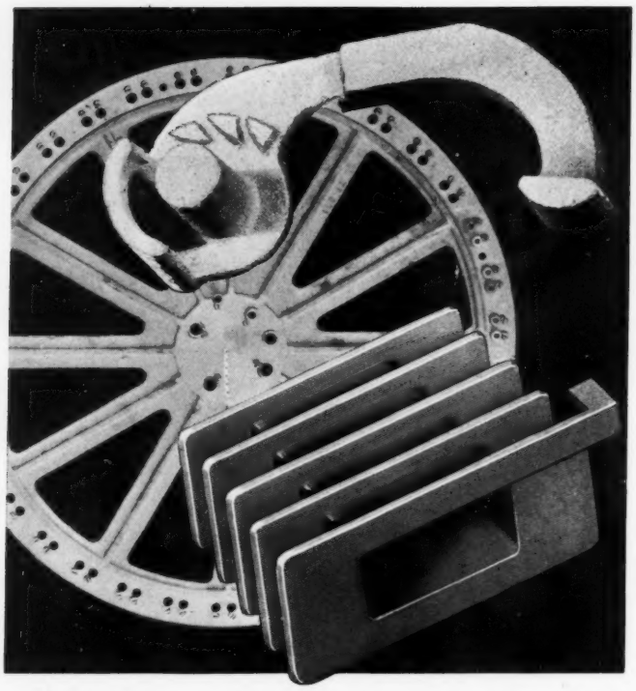
From the compact CUNO units which keep lubricants and fuel steadily free of abrasive sludge, to the big, multiple cartridge strainers handling thousands of gallons of process liquids and coolants per minute, there's a CUNO FILTER in a size and type to meet your temperature, pressure and viscosity conditions. Ask for the facts.



Schematic section of a typical CUNO FILTER showing direction of flow. Your substance enters the filter case and passes under gravity, pressure or suction head through the closely spaced filtering discs which catch the suspended solids. Then, rotation of the entire element, either manual or mechanical, against the stationary cleaning blades, combs out the filter and drops the unwanted substance to the ample sump below. The filtered and cleaned substance rises through the interior of the cartridges and passes out through the outlet indicated.

CUNO
ENGINEERED FILTRATION
CUNO ENGINEERING CORPORATION - MERIDEN, CONN.

CUNO ENGINEERING CORPORATION
Dept. 50, 90 So. Vine St., Meriden, Conn.
Gentlemen: Please send me bulletin of CUNO
FILTERS for service on .....
.....
and information on your confidential engineering service.
Name.....
Company.....
Address.....
City..... State.....



FOR CASTINGS
Without "Chilled" Spots or "Blow-holes"

• Whether the castings you use are simple or complicated, you can rely on Wellman for production that is exact in every particular. Poured at scientifically controlled temperatures, there'll be no "chilled" spots to spoil cutting tools and disrupt production. Neither will there be "blow-holes" to waste machining time. The Wellman foundry formulas assure clean, accurate castings that create no machining problems.

Turn to Wellman for castings in many metals including those unusual alloys Ampco Bronze and Dowmetal.

The WELLMAN
Bronze and Aluminum Co.
5900 SUPERIOR AVENUE
CLEVELAND OHIO

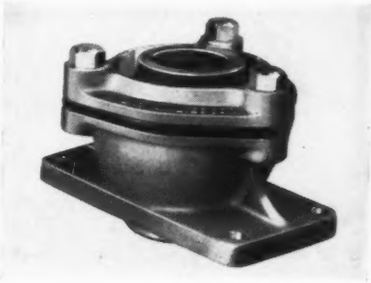
BENT TUBES • PLATED PARTS

MACHINED PARTS • CASTINGS

which enables them to yield twice the capacity for a given quantity of electrolyte.

Stuffing Box Is Foolproof

ORIGINALLY developed for marine use, a cushion stuffing box has been found suitable for many machine applications. Manufactured by the Federal-Mogul Corp., Detroit, the Equi-Flex stuffing box provides shaft protection, smooth operation and needs no servicing during the life of the installation. It is completely flexible, full-floating, self-adjusting and self-lubricating, dampens vibration and is silent in operation. The stuffing box compensates for shaft misalignment, accommodates a total of 20 degrees angularity and considerable eccentricity without binding or excessive wear. Used strictly as a bearing, it can be provided with a suitable bushing of any required analysis instead of the packing element with which it is filled when used as a stuffing box. The degree of flexibility of the entire unit can be controlled through the material selected for the flexible element.



Shaft misalignment up to 20 degrees is compensated for in this self-adjusting stuffing box

Plastic Suited for Electrical Parts

DEVELOPED for use on high frequency radio and electrical equipment, a new phenolic molding compound, known as Durez 1601, has been announced by General Plastics, Inc., North Tonawanda, N. Y. The power factor of the new material is .34 per cent which is considerably lower than any plastic of its type. It also has excellent molding qualities which permit its use for a variety of applications such as X-ray machines, diathermy apparatus, high frequency measuring and research equipment and short wave radio parts.

Takeup Screw Has Many Uses

PROTECTED from dust and dirt, a new screw takeup for conveyors, elevators and other related machines has been announced by the Jeffrey Mfg. Co., Columbus, O. The adjusting screw is protected from dust and dirt by an inverted U-shape shield which

"OUR INSTRUMENTS DEPEND ON THESE SWITCHES... they are invaluable"

KON-NEC-TORS

The performance of this well-known manufacturer's instruments is linked inseparably with the unfailing performance of General Electric Mercury Switches. To quote their own comments: "We have never had the slightest trouble with these switches. They must always be ready to function whenever called upon, and must continue to work perfectly over a long period. Failure of a mercury switch to go into action when tipped by the cam would mean either an interrupted flow of gas or air, or it would mean a broken valve."

Such satisfaction is typical of the many users of General Electric KON-NEC-TORS who demand maintenance-free switches and no variation in contact resistance. These switches are forever maintenance-free . . . there are no parts to wear out . . . and the inherent snap-action of the mercury assures clean, positive make-and-break. They are wholly glass-enclosed and safe from corrosive fumes or gases.

Drop us a line. We will be glad to tell you which of the many types is best suited for your particular job . . . General Electric Vapor Lamp Company, 825 Adams Street, Hoboken, New Jersey.

GENERAL ELECTRIC VAPOR LAMP COMPANY

821K

THESE MANUFACTURERS SELECT DUMORE MOTORS FOR EXTRA *Power Hours*

CONSOLIDATED CAR HEATING CO. ★ CENTRAL SCIENTIFIC CO. ★ J. C. DEAGAN, INC. ★ ECLIPSE FUEL ENGINEERING CO. ★ INTERNATIONAL REGISTER CO. ★ BEECH AIRCRAFT CO. ★ AMERICAN INSTRUMENT CO. ★ PHILADELPHIA AIR TRANSPORT CO. ★ McKESSON APPLIANCE CO. ★ REEVES PULLEY CO.

"Dumore Motors exceed specifications for power"—comments a manufacturer of aircraft who chose Dumore to operate retractable landing gear . . . . Hundreds of others find Dumore motors deliver *more power* over *longer periods*—and here's why:

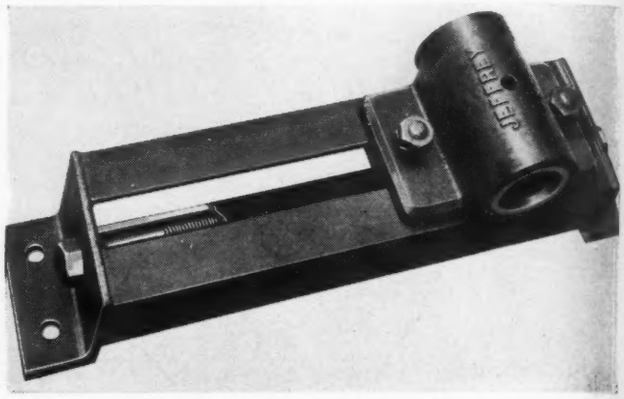
1. *Vibration-less running* is assured by Dumore *dynamic balancing.*
2. *100% electrical contact* is secured by special Dumore swaging of armature leads.
3. *"Breathing" of armature winding is eliminated* by expanding at high speed and then sealing.
4. *Maximum brush life is assured* by grinding commutators concentric with bearings.
5. *Motors are "run in"* to seat brushes.
6. *Five-time factory inspection* is supplemented by *engineering inspection.*

No matter what your requirements—maximum power is restricted space . . . . difficult mounting . . . . unusually light weight . . . . absolute uniformity for continuous load . . . . or maximum torque for intermittent load . . . . your needs will be met in the wide selection of Dumore fractional H.P. motors—1/600 to ¾ h.p. . . . . with parts "tailored to fit" specific "hookups" under the direction of Dumore Engineers. Engineering Service Application blank sent with new catalog. Write today.

THE DUMORE CO., Dept. 127-E, RACINE, WIS.

DUMORE
FRACTIONAL HORSEPOWER
MOTORS

extends from end to end of the takeup frame. The sliding base casting, which carries an adjustment nut of bronze, is cored out in such a way that it slides freely over the shield, thus relieving the shield of any



Adjusting screw is protected by inverted U-shaped shield which extends length of takeup frame

function other than protecting the screw. As the adjusting screw does not travel but remains inside the frame, it is protected from damage at all times. It is also relieved of all load for, after adjustment, the bearing is rigidly clamped to the steel frame.

Motor Suited for Textile Service

SEVERAL novel design features are incorporated in a screenless open motor, announced by General Electric Co., Schenectady, N. Y., for textile service. The ventilating system of the new motor is designed with particular attention to positive lint expulsion. Any free lint or dust in the ventilating air is forced through

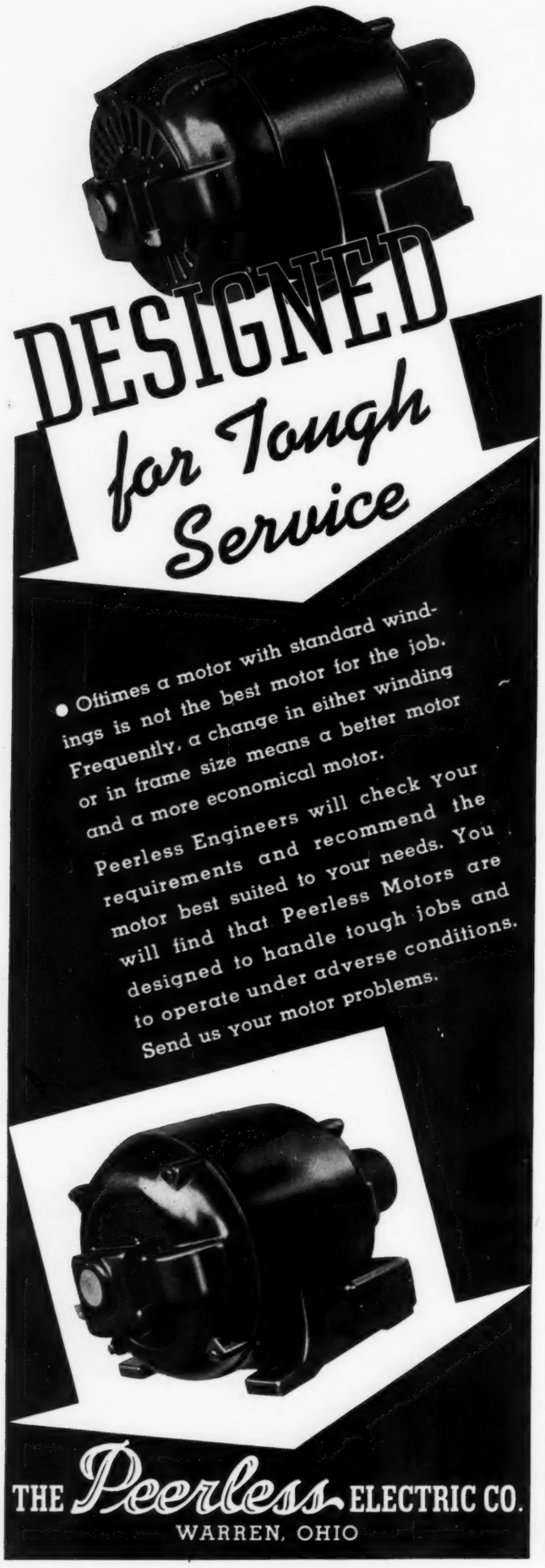
Dust is forced through large air passages and discharged through stator frame without harming bearings in this screenless motor

large, unobstructed air passages and is effectively discharged through large openings in the stator frame. The motor is furnished with an indestructible rotor with a cast-aluminum winding, and smooth, solid end rings. Cast fans are securely keyed to the shaft. End frames are of malleable iron and the outer and inner rings and cross-pieces form an arched truss of great

Kem Art Metal Finish has won the unstinted praise of manufacturers in all fields for its share in helping create many of the most sensational product successes of the day. Why?

Because Kem Art Metal Finish produces a colorful, rich finish of remarkable beauty in texture with but a single coat! It requires no undercoater. It hides any minor surface imperfections—eliminating costly polishing operations, and bakes to a fine, perfect texture even on corners and beads. Kem Art Metal Finish is available in colors picked for their popularity and suitability for different applications and styling trends—from bobbie pins to machines. Let the S-W Finish Engineer show you how this finish can give your products greater market appeal at savings to you. The S-W Industrial Color Service is also your source of aid on effective color treatments. No cost or obligation. Write The Sherwin-Williams Company, Cleveland, Ohio, and all principal cities.

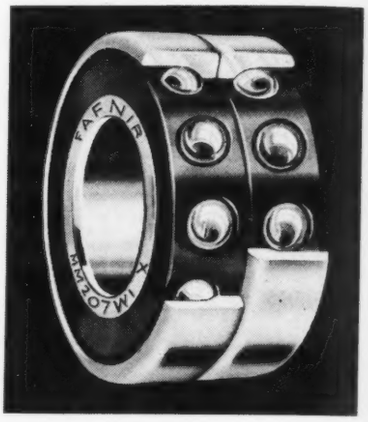
SHERWIN-WILLIAMS INDUSTRIAL FINISHES


DESIGNED
for Tough
Service
• Oftimes a motor with standard windings is not the best motor for the job. Frequently, a change in either winding or in frame size means a better motor and a more economical motor.
Peerless Engineers will check your requirements and recommend the motor best suited to your needs. You will find that Peerless Motors are designed to handle tough jobs and to operate under adverse conditions. Send us your motor problems.
THE Peerless ELECTRIC CO.
WARREN, OHIO

rigidity. Cast-iron end shields provide a rigid structure to support the ball bearings.

Unusual Accuracy Features Bearings

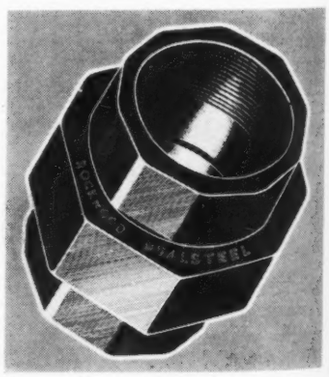
BALL bearings built primarily for use in high-speed grinding equipment where shaft speeds range from 5000 to 40,000 RPM have been brought out by The Fafnir Bearing Co., New Britain, Conn. Unusual accuracy is attained in these bearings as they are inspected, gaged and tested in a special department. Known as the X type, the balls in the bearings are held within one-hundred thousandths of an inch on an electro-limit gage. The bearings are furnished in nine sizes, ranging from 12 mm to 45 mm bore, exclusively in duplex pairs.



Bearing accuracy is carried to extremely close limits in this special type

Union Possesses Extra Strength

EXTRA strength and a high resistance to corrosion are combined in the Dualsteel union placed on the market recently by Rockwood Sprinkler Co., Worcester, Mass. It is well suited for heavy duty applications, having a tensile strength of 80,000 pounds per square inch. A Brinell rating of 180 shows a hardness which prevents excessive damage to the outside surface of

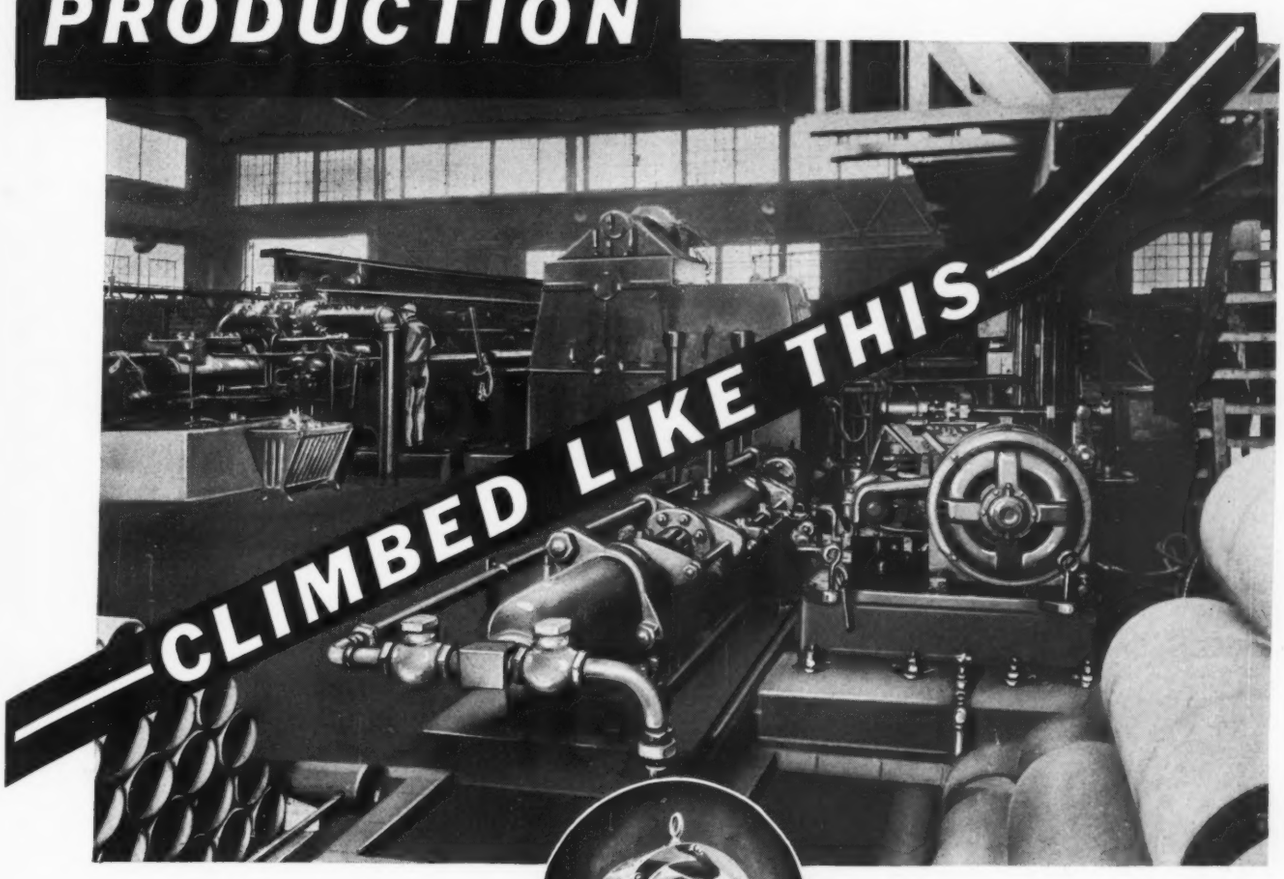


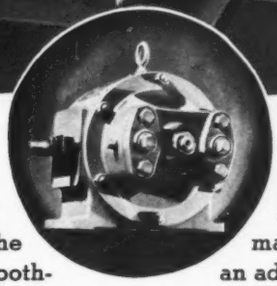
Extra hardness in this new steel alloy union prevents nicking of surface with wrench

PIPE PRODUCTION

UNCOVER THE FACTS!

CLIMBED LIKE THIS





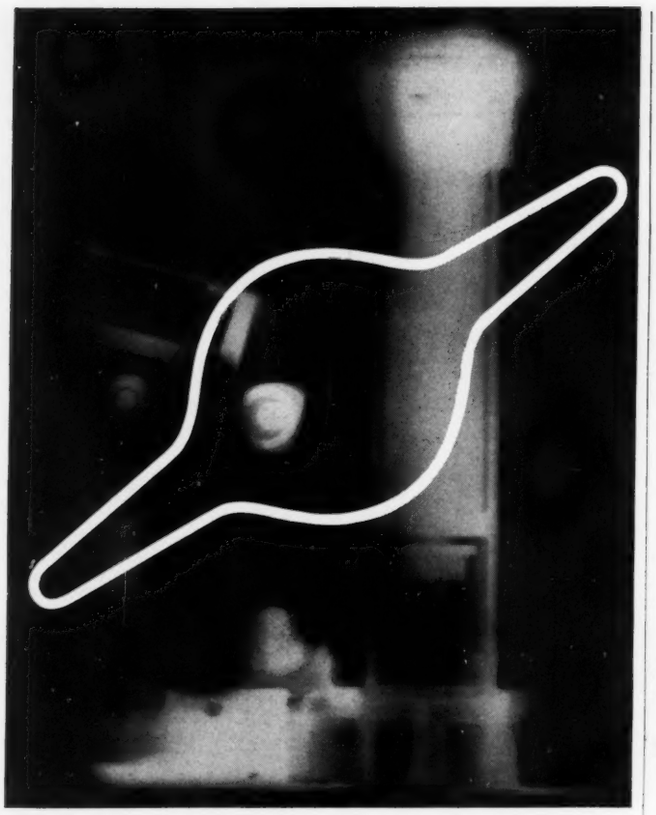
FLUID POWER is oil under pressure. We talk about the flexibility of Fluid Power (or oil under pressure), the ease of controlling Fluid Power, its smoothness, reversibility, variability. But we overlook, says one customer, the increase in production which Fluid Power makes possible . . . This particular customer manufactures pipe. Each section has to be tested thoroughly, rapidly, safely. A patented system of pipe testing in his plant, using the Hele-Shaw Pump, tests *2½ times as much pipe per hour* as the original equipment. Fluid Power operation is faster because the operator can adjust pressures quickly, over an infinite range between minimum and maximum. Flexibility of installation is also an added factor—as it makes remote control possible. There are actually seven other important advantages for Fluid Power in this machine . . . Whether linear or rotary motion is involved, if you want to save productive time . . . *look* into Hele-Shaw Fluid Power operation. Don't *overlook* the fact that Fluid Power has many other advantages. We shall be glad to help you *Drive with Fluid Power.* Write for our Catalog F, giving your name, title, company name and address.

Division: AMERICAN ENGINEERING COMPANY
2502 Aramingo Avenue, Philadelphia, Penna.

A-E-CO HELE-SHAW *Fluid Power*

A-E-CO HELE-SHAW PUMPS, MOTORS AND TRANSMISSIONS

Other Products: A-E-CO Taylor Stokers, A-E-CO Lo-Hed Monorail Electric Hoists, A-E-CO Marine and Yacht Auxiliaries



WE X-RAY IT —

YOU FORGET IT!

Bring the experience of Graton & Knight packing engineers to your drafting board . . . when your design gets to the Packing Point. You may be saving time, worry and expense later on, by letting our "X-Ray Thinking" recommend the best packing for a piece of equipment that has yet to be built.

"PERFECT PACKINGS"
says the customer

Packings large and heavy, but pliable enough to provide a perfect seal under 80 pounds . . . that was their requirement. From specialized leather developed in the Home of Research for resistance to oil, water, gas, heat, semi-corrosive liquids, etc., packings were built — from design specifications — that in operation were described as "perfect."

WHEN YOU REACH THE PACKING POINT*, WRITE OR WIRE

Graton and Knight
HOME of RESEARCH
WORCESTER, MASS.

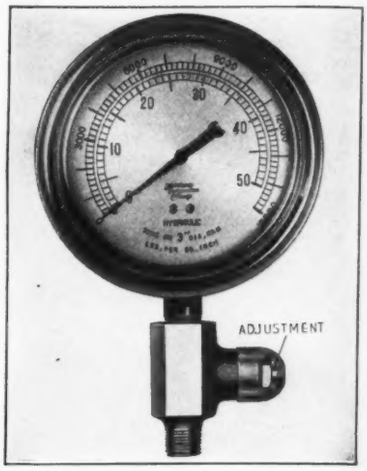
*The point in any design where the choice of the right packing comes up.

6829

the union when subjected to wrench abuse. Corrosion resistance is increased by the Parkerizing process which also acts as a thread lubricant, assuring ease in disassembly of union parts.

Pulsation Dampener Is Offered

DESIGNED to level off the peaks and valleys caused by oscillating pressure, a pulsation dampener has been developed recently by the Jas. P. Marsh Corp., 2073 Southport avenue, Chicago. The device protects pressure gages from excessive pulsation in pressure. It

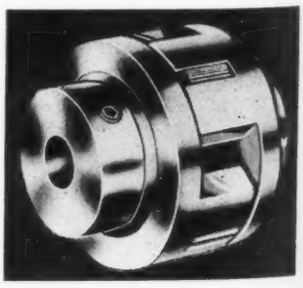


Gages may be easily read when pulsation dampener is used to level off pressure oscillations

is suitable for use with all types of equipment where there is rapid pulsation causing the gage needle to oscillate violently. Without a dampener it is impossible to obtain a reading of the gage on some types of pressure lines. The instrument is applicable to all types of hydraulic production machinery, to air and gas pressure lines and on equipment operating below atmospheric pressure.

Coupling Is All Steel

RECOMMENDED for use with fuel pumps, fans, generators and other power transmission equipment



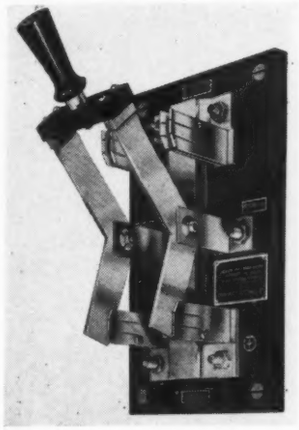
Although of all-steel construction, coupling possesses flexibility and resiliency

up to ¾ horsepower, a new flexible coupling has been placed on the market by John Waldron Corp., New

Brunswick, N. J. This all-steel coupling provides free and independent lateral floating of the connected shafts, accurate alignment surfaces, an assembled one-piece steel center member and large load carrying surfaces. It may be used on shafts up to ¾-inch in diameter.

Reversing Switch Easily Operated

CONTACT in either direct or reverse is easily made in a reversing switch introduced recently by J. C. Miller Co., Grand Rapids, Mich. It is only necessary to move the switch handle through an arc of 60 degrees to change the current flow. Ample adjustments



Handle of switch only moves through an arc of 60 degrees to reverse current

are provided for keeping the jaws and blades tight, insuring positive contact. Terminals are plainly marked on the base for installing convenience. The new switch was developed for use with electroplating equipment which calls for both cathodic and anodic current. It is suited also to a number of applications where current reversal with a minimum of working parts is required.

Bearing Seals Are Dirtproof

DUST and dirt-proof seals for Shafer roller bearing pillow blocks, intended for use in exceptionally dirty conditions, for slow speed applications and for other bearing installations requiring additional protection to the bearing, have been developed by the Shafer Bearing Corp., 35 East Wacker Drive, Chicago. These auxiliary cap seals are available in two types, open and closed end, in a full range of sizes. They are furnished with felt closures, but other types of closures may be provided for unusually wet or dirty conditions.

Primer for Chromium Is Developed

CHROMIUM is notably difficult to lacquer or enamel; in fact, no known type of air-drying lacquer will adhere to it satisfactorily. However, by the use of a

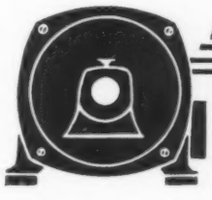
Specialists in Gear Head as well as Standard Motors

Designed to share its *UNVARYING POWER* with every exacting need, B-LINE Gear Head Motors possess the versatility of every conceivable angle of operation. Space prohibits the illustrating of each type and mounting available. We therefore suggest that you present your individual problem to our competent engineering staff.

Gear-head motors form an important part of the ever popular B-LINE. Like their motor proper, the gear-head assembly is possessive of the finest materials and craftsmanship available. Their integral design produces a unit of *reliability, adaptability, longevity* and *low cost.*

Permit us to recommend through a thorough understanding of *better* motor control.

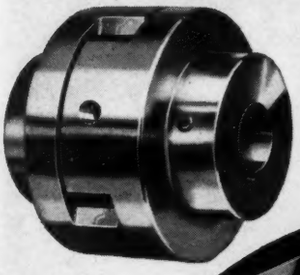
Geared Head Motors from 1/6 to 10 H.P.



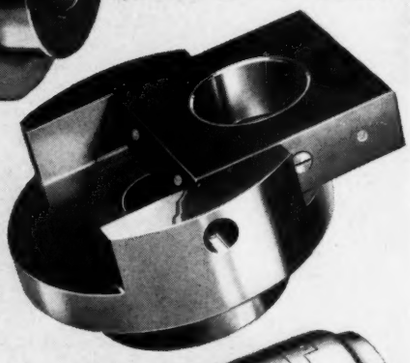
B-Line

THE BROWN-BROCKMEYER Co., Inc.
DAYTON OHIO

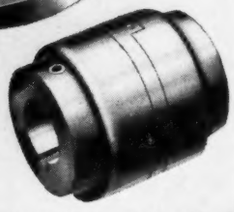
THE D. O. JAMES
FLEXIBLE COUPLING



An outstanding success for compensating the misalignment of power drives without excessive power loss or wear.



Simple construction. Mechanically Flexible. Easy to line up. Noiseless. No back lash. Self-lubricating. Creates no end thrust within itself.

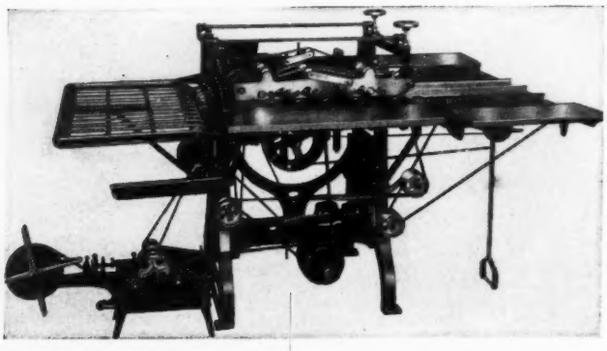


THE D. O. JAMES HEAVY DUTY UNIVERSAL FLEXIBLE COUPLING takes care of the misalignment which arises after installation and operation of driver and driven machines.

FOR ALMOST FIFTY YEARS MAKERS OF EVERY TYPE OF SPEED REDUCER AND CUT GEAR

D. O. JAMES MANUFACTURING CO., 1114 W. Monroe St., CHICAGO

PULLMORE CLUTCHES
"Have what it takes"



One of the many different kinds of equipment in which Pullmore Clutches are used is the stripping machine illustrated. Machines of this kind are used in bookbinderies throughout the world. With this widespread distribution, reliability and durability are at a premium. The manufacturers of this machine write "We have used Pullmore Clutches for several years and have yet to find one that we have had to replace."—conclusive proof that Pullmore Clutches "have what it takes" for dependable clutch performance. Pullmore Clutches are made in single and double types, for operation in oil or dry, in capacities up to 75 h.p. They are compact, efficient, easily incorporated in machine designs. Write, today, for detailed information.

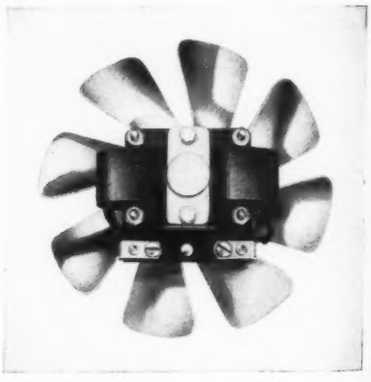
ROCKFORD DRILLING MACHINE DIVISION
Borg-Warner Corporation, 304 Catherine Street, Rockford, Illinois

Sold by MORSE CHAIN CO., Ithaca, N. Y. Offices in principal cities

new primer, recently developed by Maas and Waldstein Co., Newark, N. J., chromium can be finished in any desired color. The new product, known as "Chroprime," is a clear primer which can be applied to the metal surface by spraying or dipping, after which it is baked. It adheres tenaciously to the metal and provides an excellent foundation for any kind of lacquer enamel. It resists heat, remains flexible and permits the metal to be engraved after it is applied. The new primer can also be used as a durable undercoat for finishing other metals.

Motor Has High Starting Torque

EXCEPTIONALLY high starting torque is possible with a small electric motor developed by Russell Electric Co., 332 West Huron st., Chicago. Equipped with a fan the motors are especially suited for small electric fan-type heaters, humidifiers, and similar applications where it is desirable to move a moderate volume of air against low static pressures. Substantial die-cast bearing brackets carry exceptionally large oilless bearings which never require lubrication. The motor is perfectly symmetrical and has four studs for mounting. The 2-pole motor draws 15 watts and is available for either line or low voltage, 60 cycle, alternating current use.



Attention to lubrication is obviated by the use of oilless bearings in this small motor

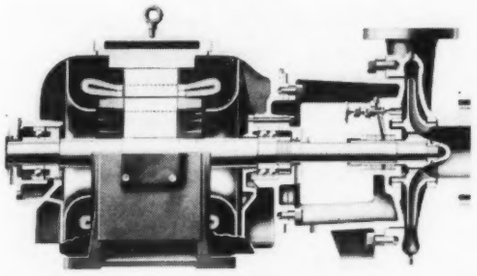
Finish Resists Corrosive Action

EXTREME flexibility has been developed in a new corrosion-resistant finish announced by Roxalin Flexible Lacquer Co., Inc., Elizabeth, N. J. Known as Roxyn-C, this all-color line of air-dry or bake-dry finishes combines flexibility without softness which makes them ideally adapted to severe forming operations. Acids, alkalis, alcohol, disinfectants, cleaning solutions in powerful concentration have little or no deleterious effect on the finish. This anticorrosive characteristic is attained from the properties of a new raw material

which has been used for the first time in the preparation of finishes.

Motor and Pump As Unit

A LINE of motor driven centrifugal pumps for capacities from 5 to 1200 gallons per minute and heads of 10 to 230 feet has been announced by the De Laval Steam Turbine Co., Trenton, N. J. The pump is mounted upon the end bell of an electric motor, the two forming a compact and self-contained unit, with only one shaft and two bearings. The unit is recommended for handling cold or hot water, brine, chemical solutions, extracts, juices, liquors, oil and gasoline. Casing of the pump is cast iron, while the impeller, wearing ring, shaft sleeve, stuffing box gland and lantern ring are bronze. All pump parts can be removed without disturbing the motor.



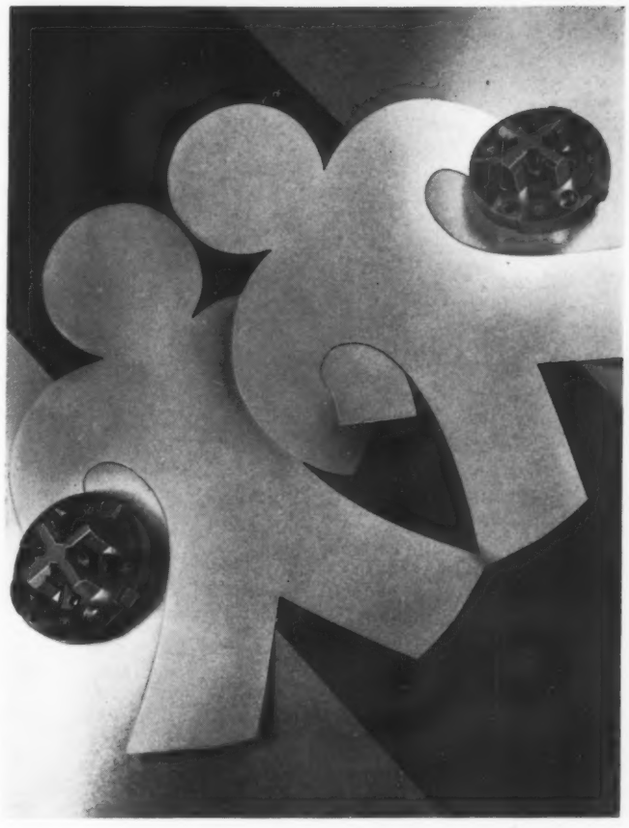
Single shaft supported on two bearings is provided for pump and motor in this unit

Pillow Block Is Rubber Insulated

VIBRATION and noise in revolving shafts have been reduced appreciably with an insulated pillow block introduced by Dodge Mfg. Corp., Mishawaka, Ind. A synthetic rubber insulating band, oil and heat-proof, cushions vibration and insures quiet operation. A self-oiling, composition bronze bushing feeds oil to shaft by capillary action while an absorbent filler holds oil in reservoir and prevents over lubrication. The inner housing of the bearing is provided with a liberal oil reservoir which entirely surrounds the shaft, allowing the bearing to be mounted in any position without danger of leakage or interference with the oil supply. The bearing is designed especially for fan and blower service and household or office applications.

Plastics Possess Shock Resistance

HIGH impact resistance is afforded in a molding material placed on the market last month by Bakelite Corp., New York City. The new line of shock-proof plastics ranges in impact strength on an A.S.T.M. standard test specimen from .22 to 2.0 foot pounds. Generally speaking, these molding materials may be classi-



Identical twins

YET 100,000 PIECES APART

The reputation of the molded plastic division of Auburn Button Works of quality moldings has been gained by delivering precise molded parts—the last exactly like the first regardless of the size of the order.

The ample production facilities of Auburn—its reputation for prompt service to all industry—and its 60 years of precision molding experience—are your guarantee of production that meets your schedules exactly.

Let Auburn study your specifications—Our years of experience may help you to time and money saving short cuts.

Established 1876

MOLDED PLASTICS DIVISION OF
AUBURN BUTTON WORKS, Inc.
AUBURN, N.Y.

Unbreakable Body.

Oil feed adjustment with shut-off switch.

Sight glass in shank to adjust oil feed to proper volume.

Self-closing hinge cover for easy filling.

Send for GITS Oiler Chart

GITS BROS
MANUFACTURING CO.
1861 S. Kilbourn Ave. CHICAGO

THIS DRAWING TABLE IS ALWAYS RIGID

No. 1802 Table
Top size 36" x 60"

HAMILTON STEELWOOD DRAWING TABLE

A drawing table that has loose and wabbly joints is about as good as no drawing table at all. Steelwood drawing tables remain rigid and free from annoying repairs for as long as you use them. The welded steel framework makes this possible and insures many years of continuous usage. Write today for complete information.

HAMILTON
Drafting Room FURNITURE

Hamilton Manufacturing Company
Two Rivers, Wisconsin—Dept. MD-5-37.

Please send me at once complete information on the Hamilton Steelwood Drawing Table. I will in no way be obligated by requesting this.

Name.....

Firm Name.....

Address.....

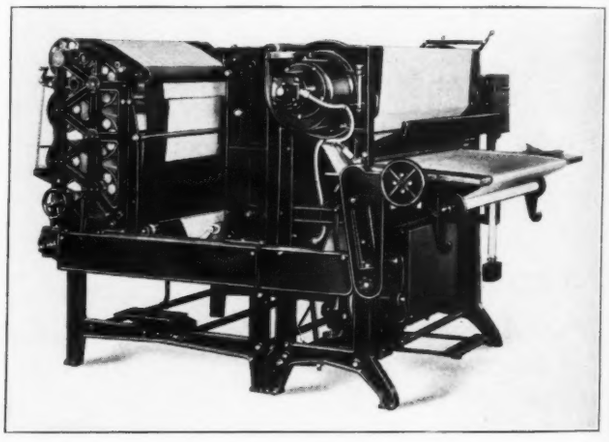
City & State.....

fied as improved impact, medium impact, medium-high impact and high impact. The new plastics are particularly suitable for handset telephones, instrument cases, junction boxes, oil well equipment, rayon spinning buckets and other parts requiring relatively high impact or shock resistance.

Engineering Department Equipment

Blueprinter Is Automatic

FRICTIONLESS revolving contact and intense rays for fast printing are features of the 3H Revolute automatic, blueprinting machine brought out recently by Paragon-Revolute Corp., 76 South avenue, Rochester, N. Y. Besides these features the new model offers rapid, economical blueprinting facilities for turning out smooth, flat prints without wrinkle or curl. The calendering effect of the six aluminum drying cylinders gives the prints a smooth finish to which dust and dirt do not easily adhere. The machine is fully



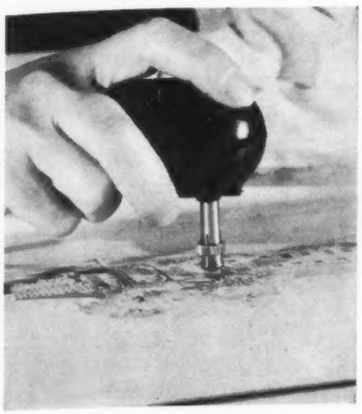
Thermostat control assures uniform drying temperatures of blueprints made on the Paragon machine

equipped for making both blueprints and van dykes and offers very economical drying operation with uniform drying temperature assured by the thermostatic control which is built in to each machine. New models may be 42 or 54 inches wide, operating on 220 volts direct or alternating current with gas or electrically-heated dryers.

Electric Eraser Aids Draftsman

MECHANISM of the small electric eraser made by the Kueffel & Esser Co., Hoboken, N. J., is contained in a two-piece molded housing which fits in the palm of the hand. The erasing unit is designed for drafting board practice, eliminating the scuffing motion

of the hand eraser and allowing it to be directed as accurately as a pencil point. The motoraser weighs six

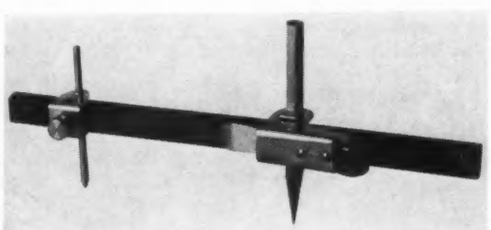


Small electric eraser may be held in palm of hand

ounces. A control button is placed so that it may be easily operated by the finger.

Beam Compass Easily Adjusted

SIMPLY constructed, a beam compass which will hold either pen or pencil has recently been introduced by A. P. Bartusch, 775 Walnut st., Lockport, N. Y. For adjustments it is only necessary to propel the roller of the holder along the beam. Any standard pencil or ruling pen will fit the compass and may be easily inserted by loosening the center pin holder with a finger

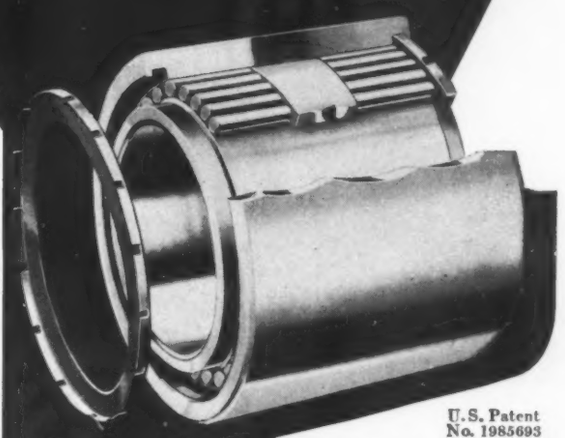


Standard sizes of pens and pencils are easily fitted into this beam compass

screw. Three different beams are available permitting maximum radii of 12, 24 and 36 inches. The smallest radius possible with the compass is 1⅝ inches. Metal parts are finished in nickel silver, well balanced and attractive appearing.

CORRECTION—In the article "New Applications Show Progress in Belt Drving" which appeared in the Machine Drives supplement of the April issue, the motor base shown in the illustration on page 86 was a Rockwood standard motor base; the text matter, however, referred to another type of base produced by the Rockwood Mfg. Co. which incorporates spring tension control. The error was caused by the elimination of one of the illustrations for the article at the time of going to press.

Improve Your Products with McGILL MULTIROL PRECISION NEEDLE BEARINGS



U. S. Patent No. 1985693

REDUCE bearing wear and replacements to the minimum in the equipment you design or build—use MULTIROL Precision Bearings, (the original needle type). Their great load carrying capacity enables them to run many times longer than plain bearings, or even other anti-friction types, especially under sustained heavy, or intermittent shock loads. And their small overall size often makes them interchangeable dimensionally with existing bronze or babbitt bearings. Much less oil and grease are required, too. The many MULTIROL designs adapt them to a wide range of applications in practically every kind of equipment from sewing machines to gasoline and diesel engines.

Send for MULTIROL Bulletin

Stocked in Many Sizes

Stocked in many standard sizes from 5/8 to 6-inch bore, single and double rows of rollers, at low, volume production prices. Corrosion and heat-resisting types, and other special designs to order.

McGill Manufacturing Company
Bearing Division, 1450 N. Lafayette St., Valparaiso, Indiana

The Swing

is to

ROPER

Coolant

PUMPS

Reason . . . they do one whale of a job wherever they are put to work. Roper Coolant Pumps have the punch to reach the deepest cuts and bores and they are engineered to give extra long service. Made in practically all types needed for handling cutting compounds and lubricating fluids on metal working machines.

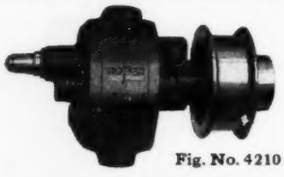


Fig. No. 4210

Write for

Bulletin R4MD

GEO. D. ROPER CORP., ROCKFORD, ILL.

Maximum Belt Drive Economy

Greater Layout Flexibility

WORTHINGTON

MULTI-V-DRIVE

with

GOODYEAR

EMERALD CORD BELTS

HIGH LOAD CAPACITY
LONG FLEXING LIFE

- **Advanced belt design**
- **Accurate sheave grooves**
- **Balanced sheave rotation**
- **Moisture and shock proof**

25,000 STOCK COMBINATIONS
. . . UNLIMITED SPECIALS

Fractional to 1500 horsepower

Write or phone the nearest Worthington Office or Dealer

WORTHINGTON PUMP AND MACHINERY CORPORATION

HARRISON NEW JERSEY

MV7-B

MEETINGS *and* EXPOSITIONS

SEVERAL papers of particular interest to the designing engineer will be given at the semiannual meeting of the American Society of Mechanical Engineers to be held May 17 to 21 at Detroit with headquarters at the Statler Hotel. "Industrial Bearing Design as Influenced by Automotive Practice"; "Rubber Cushioning Devices"; "Welded Fabrication of Large Frames"; "Hydromatic Welding of Frames," and "Description of Machine Tests for Measuring the Minimum Film Thickness with Bearing Metals" are the titles of a few. The papers' committee, headed by Harry T. Woolson, executive engineer of the Chrysler Corp., has set up a series of six general sessions which will be held in the mornings and afternoons of Tuesday, Wednesday and Thursday, May 18, 19 and 20.

American Gear Manufacturers association will hold its 21st annual meeting May 24 and 25 at Galen Hall, Wernersville, Pa. Papers scheduled to be presented at this meeting which treat the field of the machine designer are "Gear Castings with Reference to Cast Iron" by O. Smalley, president, Meehanite Institute of America; "Automobile Transmissions, Testing, Etc." by J. O. Almen, head dynamics department, research laboratories, General Motors Corp., and "Application Factors for Helical and Herringbone Speed Reducers" by S. L. Crawshaw, application engineer, Westinghouse-Nuttall Works.

May 17-21—

American Society of Mechanical Engineers. Semi-annual meeting to be held at Statler hotel Detroit. C. E. Davies, 29 West Thirty-ninth street, New York, is secretary.

May 17-19—

National Electrical Manufacturers' association. Annual meeting to be held in Hot Springs, Va. W. J. Donald, 155 East Forty-fourth street, New York, is managing director.

May 17-21—

American Mining Congress. Annual coal mining convention and exposition to be held in Cincinnati. Julian D. Conover, 309 Munsey building, Washington, D. C., is secretary.

May 24-25—

American Gear Manufacturers' association. Twenty-first annual meeting to be held at the Galen Hall hotel, Wer-

nersville, Pa. J. C. McQuiston, Penn Lincoln hotel, Wilkinsburg, Pa., is manager-secretary.

May 29-Sept. 6—

Great Lakes Exposition. General and industrial exposition to be held at Lakeside Exhibition hall, Cleveland. Additional information is obtainable from Hill & Knowlton, 1454 Builders Exchange building, Cleveland.

June 1-3—

American Society of Refrigerating Engineers. Semi-annual meeting to be held at French Licks Springs Hotel, French Licks, Ind. David L. Fiske, 37 West Thirty-ninth street, New York, is secretary.

June 7-11—

Association of Operative Millers. Flour mill machinery and supplies exposition and annual meeting to be held at Statler hotel, Detroit. C. W. Partridge, 522 Board of Trade, Kansas City, Mo., is secretary.

June 8-9—

Radio Manufacturers association. Exhibition and annual meeting to be held at Stevens hotel, Chicago. Bond Geddes, 1317 F street, Northwest, Washington, D. C., is secretary.

June 9-10—

National Warm Air Heating and Air Conditioning association. Semi-annual meeting to be held at Hotel Cleveland, Cleveland. Allen W. Williams, 50 West Broad street, Columbus, O., is secretary.

June 21-25—

American Institute of Electrical Engineers. Summer meeting to be held at Milwaukee. H. H. Henline, 33 West 39th street, New York, is secretary.

June 21-24—

American Society of Agricultural Engineers. Annual meeting to be held in Urbana, Ill. Raymond Olney, St. Joseph, Mich., is secretary.

June 21-July 16—

Massachusetts Institute of Technology. Special summer school and conferences on "Strength of Materials," to be held at Massachusetts Institute of Technology, Cambridge, Mass., for four weeks beginning June 21. Prof. John M. Lessells, Department of Mechanical Engineering, Massachusetts Institute of Technology, is director of the summer school.

June 29-July 2—

Society for the Promotion of Engineering Education. Mechanical engineering division to hold conference in Cambridge, Mass., to consider various phases of mechanical engineering. Conference to be held June 28 and 29, preceding annual meeting of the society. Prof. Frank L. Eidmann, Columbia university, New York, is chairman of the conference.

IXL GEAR INSPECTORS
increase your sales

● When your name goes on your product, reputation is at stake. The measure of its service depends on the integrity of each component part.

Sales increase as the reputation for quality of your line grows.

When you specify and use IXL speed reducers or gears of (any type or size), IXL inspectors insure you against faults and complaints and your sales volume quickly responds. IXL engineers feel keenly this responsibility to machine builders.

In the finest equipped, largest and oldest exclusive gear plant in the world are designed and produced the most complete line of quality Helical, Worm, Herringbone Speed Reducers, Powered gears and combinations for practically every industrial and commercial use. With 100,000 patterns available, many jobs that would be "special" elsewhere are standard here. In the 76 years of specializing in gear reduction application, IXL engineers have gained engineering experience invaluable to designers and builders of any equipment requiring gearing, and will gladly cooperate.

Send for "Gear Problems", sent gratis to any engineering executive.

IXL
The Mark of Quality

FOOTE BROS.
GEAR & MACHINE CORPORATION
5303 S. Western Boulevard - Chicago

• *A Complete* IXL *Line* •

Speed Reducers	*Combinations*	*Powered Gears*
Worm	*Gears of all kind*	Helical Type
Helical	Metallic	Radiating Worm
Herringbone	Non-Metallic	Gear Type

Stoker Drives • Friction Clutches
Couplings

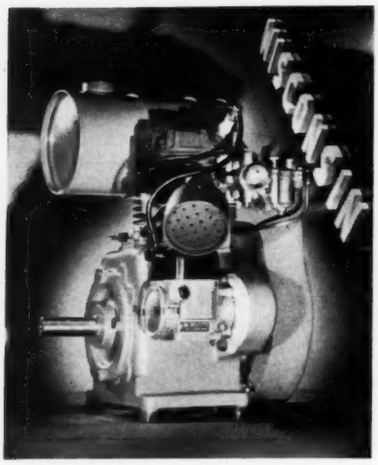
Special Machinery of all kinds
Helical Oil Well Pumping Units
Vertical Deep Well Pump Drives
Vertical Agitator Mash Tub Drives

FREE

FOOTE BROS. GEAR & MACHINE CORP., Chicago, Illinois

Please mail me, without obligation, your 600-page book, "Gear Problems."

*Company*_____
*Address*_____
*My Name*_____
*Title*_____



A reproduction of Model AB 2½ H.P. Single Cyl. Engine.

•

Single and 4 Cyl. Models 1 to 16 H. P.

MODERN EQUIPMENT NEEDS MODERN POWER

Wisconsin Heavy-Duty Air-Cooled Engines are light in weight, and compact. They are the last word in modern design.

HEAVY DUTY AIR COOLED ENGINES by WISCONSIN MOTOR CORPORATION

WISCONSIN
MOTOR CORP., MILWAUKEE, WIS.

Two Compact Centrifugal Motorpumps

—self-contained
—save expensive power take-off
—dependable

No. 204

—a new design, giving good volume at low head. Discharge is at top.

Ask for data on the full line.

No. 210

—a sturdy unit of large capacity. Discharge pipe clears motor—no elbows needed.

Brown & Sharpe Mfg. Co.
Providence, R. I.

BROWN & SHARPE PUMPS

B·S

MANUFACTURERS' PUBLICATIONS

BEARINGS—The new 146-page Booklet "S", prepared by New Departure, Bristol, Conn., in addition to containing an up-to-date listing of all available types, sizes and list prices of ball bearings, covers bearing selection, mounting directions, fits and tolerances and equivalent bearing tables.

BEARINGS—Additional sheets to "Bearing Metal Data Book" have been released by Federal Mogul Corp., 11031 Shoemaker avenue, Detroit. These cover physical properties and illustrations of bearing bronze, tin base bearing alloy, cadmium base bearing alloy, and lead base bearing alloy.

BEARINGS—In a catalog issued by Torrington Co., Torrington, Conn., about forty new sizes and types of ball bearings are listed, specifications and prices also being given.

BRAKES (MAGNETIC)—Design features, including principle of construction, housing, torque, as well as the advantages of the high duty, magnetic disk brake are discussed in loose-leaf file pages issued by Stearns Magnetic Mfg. Co., Milwaukee, Wis.

CLUTCHES—Detailed data on friction clutches, manufactured by Carlyle Johnson Machine Co., Manchester, Conn., are given in a leaflet being distributed by the company. Many improvements during the past years in the clutches are listed.

CONTROLS (ELECTRICAL)—A novel pressure regulator selector chart is being offered by Davis Regulator Co., 2523 S. Washtenaw avenue, Chicago. This chart will aid in the selection of the proper type of pressure reducing valve for any kind of service on steam, gas, air, oil or water.

CONTROLS (ELECTRICAL)—Magnetic relays, particularly adapted for transfer purposes, are covered in detail in bulletin 131, distributed by Ward Leonard Electric Co., Mt. Vernon, N. Y. Description of more than 100 relays for heavy duty (1 to 25 amperes) on direct and alternating current circuits are given.

CONTROLS (ELECTRICAL)—Struthers Dunn Inc., 139 North Juniper street, Philadelphia, Pa., is distributing its folder describing and illustrating its line of relays for

signals, power transfer, remote control and special applications; also its line of timing devices, thermostats and electric counters.

CONTROLLERS—Latest models of non-indicating controllers for temperature, pressure and time are completely described and illustrated in Catalog No. 900C, recently issued by C. J. Tagliabue Mfg. Co., Park and Nostrand avenues, Brooklyn, N. Y. The catalog contains a comprehensive discussion of various types of controllers, their applications and how they work, as well as an instrument listing.

CONVEYORS—Catalog No. 270, issued by Chain Belt Co., 1600 West Bruce street, Milwaukee, includes engineering data on belt conveyors and tables and charts for quick and convenient selection of the proper conveyor parts for any particular requirement.

FASTENINGS — "Mac-Its" Catalog, distributed by Strong, Carlisle & Hammond Co., Cleveland, gives complete data, arranged in the most practical and convenient reference form, as to the physical and use characteristics of these screws, list prices, shipping weights. Pertinent engineering information is included.

GEARS—Farrell-Cheek Steel Co., Sandusky, O., has issued a folder on cast tooth gears. Characteristics, applications and advantages of these gears are presented in the folder.

GRAY IRON—Two booklets have been issued by Gray Iron Founders' Society Inc., 1010 Public Square, Cleveland, covering information on properties, specifications, workmanship and finish, and heat treatment of gray iron. These are known as "New and Useful Facts about Gray Iron" and "O.K. After Machining", and will be of interest to the designer who wants to know what material will serve his purpose at a finished cost comparable with other means at his disposal.

HEATING UNITS—General Electric Co., Schenectady, N. Y., has published a catalog on electric heating units and devices needed for small heating jobs. Installation, application, operation, and advantages of electric heat are discussed in detail.

INSTRUMENTS — General Radio Co., Cambridge, Mass., has published a folder on its new type 759-A sound-level meter for measuring industrial noise, such as that in all types of machinery and mechanical equipment. Complete specification and general information on the features and operation of the sound-level meter are also given.

LIGHTING—Good general illumination is the subject covered in catalog pages entitled "Engineered Localized Lighting," issued by Fostoria Pressed Steel Corp., Fos-

HOW MANY

——OF THESE QUESTIONS CAN YOU ANSWER?

1 What new device saves 25% to 40% of drafting time and results in far greater accuracy?

2 How can you eliminate discoloration, brittleness and bad odor from Vellum tracings?

3 Is it possible to make a pencil tracing that will reproduce approximately as well as an ink tracing—thereby eliminating the expense of ink work?

4 By what simple, inexpensive process are black line prints made directly from the tracing—without the use of a negative, and *faster* than blue prints?

5 What process is used by engineers and draftsmen when they wish to make extensive alterations on part of a tracing, *without* redrawing the entire tracing?

You'll find the answers—and a mine of other valuable information, besides—in our new, Free Book, "Ten Doors To Progress". Mail the coupon for your copy . . . There's no obligation.

Charles Bruning Company, Inc.,
102 Reade Street,
New York City, N. Y.
Please send me your FREE illustrated book, "Ten Doors To Progress."

Name _____
Company _____
City _____
Address _____

BRUNING
SINCE 1897

793

SENSITIZED PAPERS . . . REPRODUCTION PROCESSES . . . DRAFTING ROOM EQUIPMENT . . . DRAWING MATERIAL

NEW YORK CHICAGO DETROIT BOSTON NEWARK ST. LOUIS KANSAS CITY PITTSBURGH LOS ANGELES SAN FRANCISCO MILWAUKEE HOUSTON

ALL TYPES OF

GEARS

Cut Spur, Straight and Spiral Bevel, Mitre, Spiral, Worm, Internal, Helical and Herringbone Gears, in all sizes and of all materials, Sprocket Wheels, Racks, Flexible and Universal Couplings

ALSO ALL TYPES OF SPEED REDUCING TRANSMISSIONS

Almost a half century of making all types of cut gears for every conceivable purpose has proved the D. O. James service a valuable one. Speedy production without sacrificing D. O. James manufacturing perfection assures you of quality gears *when you need them.* We offer you the accumulated experience, skill and knowledge of fifty years of successful gear making. Let us help you with your next requirements.

D. O. JAMES MANUFACTURING CO.

Established 1888

1120 West Monroe Street • Chicago, Illinois

Books in Popular Demand

Gear Design Simplified
By Franklin D. Jones $3.00

Handbook of Engineering Fundamentals
Edited by Orvid W. Eshbach.....$5.00

Ingenious Mechanisms for Designers and Engineers, Vol. II
Edited by Franklin D. Jones.....$5.00

Procedure Handbook of Arc Welding Design and Practice
Published by Lincoln Electric Co...$1.50

Materials of Engineering
By Herbert F. Moore $4.00

Corrosion Resistance of Metals and Alloys
By Robert J. McKay and Robert Worthington $7.00

Add 15c for postage

Available from

MACHINE DESIGN

Penton Building, Cleveland, Ohio

toria, O. Emphasis is placed on localized lighting where close and accurate work is done, and lamps for use on machines are illustrated in their many styles and sizes.

LUBRICATION AND LUBRICATING EQUIPMENT—Fiske Refining Co., 24 State street, New York, has prepared a leaflet covering its compound lubricants known as "Lubriplate," the main feature of which is their ability to react with metals, thereby forming a "lubriplate film" which stops wear.

LUBRICATION AND LUBRICATING EQUIPMENT—Considerable information is given on centralized, forced feed and automatic lubrication in Bulletin "D", issued by Bijur Lubricating Corp., Long Island City, N. Y. The booklet contains descriptions and illustrations of lubricating systems and equipment as applied to machinery in various fields.

MATERIALS—Lignum-Vitae Products Corp., 100 Boyd avenue, Jersey City, N. J., has issued its first number of "Fact Flashes" which is to appear periodically. Information concerning characteristics of Lignum-Vitae, a hard, self-lubricating, acid-resisting and resinous wood, as well as its various uses as parts in the manufacture of machinery and equipment are covered in the current bulletin.

MOTORS—Published periodically by Wagner Electric Corp., 6400 Plymouth avenue, St. Louis, the "Wagner Circle" covers technical and up-to-date information regarding its motors and illustrations of their applications on machines of all types.

VALVES—Now made available by Logansport Machine Inc., Logansport, Ind., is a catalog (section three) covering hydraulic valves. Dimensions and descriptions are given on hand, foot, solenoid, cam, pilot and latch operated 4-way valves; relief, by-pass, pressure regulating, feed and pilot operating valves.

VIBRATION ELIMINATION—Various types of vibration eliminators used in connection with machinery are fully described in an illustrated booklet released by Vibration Eliminator Co., 4126 Thirty-seventh street, Long Island City, N. Y. There are also many drawings showing the installation of these units.

WELDED PARTS AND EQUIPMENT—"Building a Career in Arc Welding" is an announcement by Lincoln Electric Co., Cleveland, of its advanced welding courses designed for engineers and production supervisors. The course includes practical and technical instruction. The company has also prepared a wall chart for the designing engineer and draftsman which gives symbols for welding design, allowable stresses, comparable strengths of riveted joints and other pertinent information.

Automatic Transmissions

(*Continued from Page* 48)

means of segments passing through slots in the carrier plate as shown in *Fig.* 1.

When the accelerator is released for the change from second to third speed, the coasting torque of the vehicle drives the planet housing in the direction of engine rotation as it decelerates. This reversed torque and the speeding up of the planet housing in the direction of engine rotation, permitted by the reaction clutch, results in the "throw-out" of the high speed centrifugal weights located between the planet clusters and within the planet housing drum. The high speed sliding clutch is moved back by the radial arm on each of the weights which bear against three slideable studs and a plate contacting with an intermediate coil spring. A gear clutch member keyed to the main shaft takes the drive as soon as both members become synchronized through the change in relative speeds between the planet housing and the main shaft. Upon acceleration of the engine and the engagement of the main clutch, direct drive ensues. The high speed clutch is shown in *Fig.* 3. It should be noted that with the torque reversal, the first speed shaft attempts to brake the engine; the second speed shaft is already coupled to it, thus giving a locked system at the time that the high speed clutch is attempting to engage and while the engine is decelerating. As there is no relative movement between the two high speed clutch members, no clashing can occur.

Brake Shoes Operated by Air

A pair of brake shoes are hinged at the bottom of the transmission housing and are actuated by an air chamber. The function of this brake is to stop rotation of the planet housing when shifting from neutral to reverse or forward, or when using the engine as a brake in second gear. A control button on the floor of the driver's compartment at the left of the steering column operates this brake. When the transmission is in neutral and the engine is being warmed up, the planetary housing usually turns slowly due to a slight drag of the main clutch. The application of the brake permits the initial engagement of the control elements without any clashing and overcomes any inertia of the clutch drum and the mechanism behind it.

To initiate reverse speed, the sliding clutch member on the planetary carrier plate is moved to the right to engage a gear clutch member riveted to the back of the second speed clutch drum, as seen in *Fig.* 1. As the engine is accelerated, the main clutch comes into engagement and power is conveyed through the roller clutch to the first speed sun gear. The second speed sun gear being locked stationary, the planet

TODAY'S ENGINEERING DEMANDS

An Oil Seal that Is Flexible in Design ★

Garlock KLOZURE applied to Self-aligning Ball or Roller Bearing.

THE Garlock ★ KLOZURE

THE design of the GARLOCK KLOZURE lends itself to many modifications to suit specific service requirements. Likewise, the plastic compound from which the sealing element or packing ring of a KLOZURE is made may be molded into a great variety of cross-sectional shapes. Because of this great flexibility in design and material, it is possible to make a special KLOZURE to suit any application.

Besides having the advantage of being flexible for design purposes, the KLOZURE sealing ring has other exceptional qualities—it is dense, grainless, resilient, tough, oil-resistant and heat-resistant. Garlock standard KLOZURES are made in a complete range of sizes. Special designs made in accordance with your specifications. Write for new catalog.

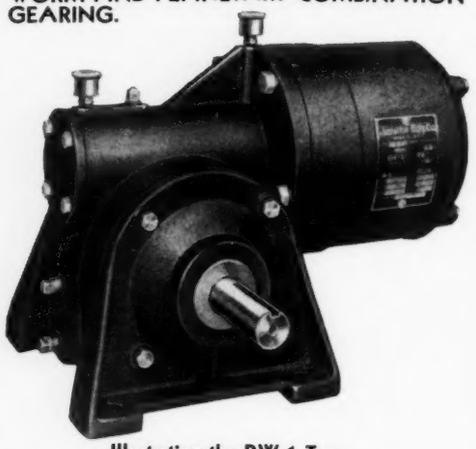
THE GARLOCK PACKING COMPANY., PALMYRA, N. Y.
In Canada: The Garlock Packing Company of Canada, Ltd., Montreal, Que.

1887-1937 FIFTIETH ANNIVERSARY

GARLOCK

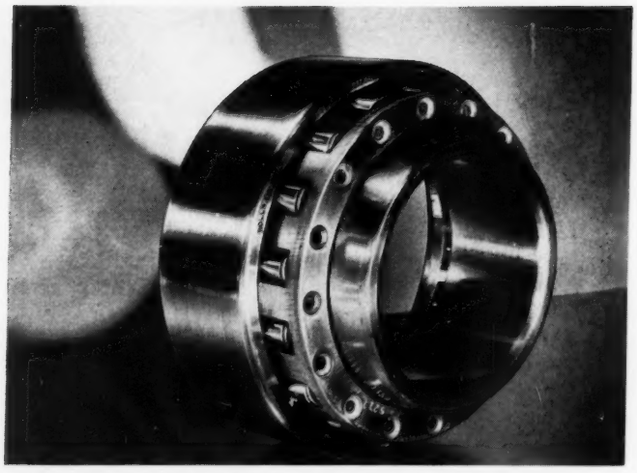
Janette
MOTORIZED SPEED REDUCERS

16 DIFFERENT TYPES
1/50 to 7 1/2 H.P. RATINGS—FOOT—FLANGE—FOOT AND FLANGE MOUNTINGS . . . . WORM—HELICAL—SPUR—WORM AND PLANETARY COMBINATION GEARING.



Illustrating the RW-1 Type
The diversity of the Janette custom built line of motorized speed reducers enables us to supply a machine for almost any purpose. Let our engineers help in selecting the right type for your application.

Rotary Converters—Generators—Motors—Motor-Generators
Janette Manufacturing Company
556-558 West Monroe Street Chicago, Ill. U.S.A.
BOSTON - NEW YORK - PHILADELPHIA - CLEVELAND - MILWAUKEE - LOS ANGELES
DETROIT - SEATTLE



BETTER THAN "GOOD ENOUGH"

Rollway Bearings are not built for engineers content to specify one bearing as "good enough" for all purposes. The greater efficiencies of Rollway cylindrical roller, radial, and thrust bearings for certain applications are for the engineer interested in increasing the all around accuracy of his specifications. Our wide experience as bearing specialists is yours for the asking. A Rollway Analysis is the first step. It costs you nothing and may save you much. Write—

ROLLWAY BEARING CO., INC., SYRACUSE, N. Y. Factory Representatives in—Boston, Chicago, Cleveland, Detroit, Philadelphia, Pittsburgh, and Youngstown. Agents: Houston, Texas; Tulsa, Okla.; Birmingham, Ala.; Precision Bearings, Inc., Los Angeles, San Francisco, Portland, and Seattle.

CYLINDRICAL ROLLER
ROLLWAY BEARINGS

gear clusters "walk" around the sun gears, carrying the planetary housing in a direction opposite to that of engine rotation and with them the main shaft sun gear at reduced speed.

At the right of the high speed clutch is located a throw-out shoe, shown in *Fig.* 2. It operates only when shifting from third to second or while the transmission is in neutral or reverse. It is actuated by the transmission control lever in the driver's compartment or by the control button. Its purpose when shifting from third to reverse or neutral (when planet housing is rotating in reverse speed or during warming up), is to prevent the high speed clutch from being moved back into engagement with the main shaft clutch member.

The disrepute of the planetary transmission in this country is naturally unwarranted as indicated by its great success and use in England. The quietness of the gears in the "Mono-Drive" is exceptional in view of the use of spur gears. They eliminate any side thrust problem. The load distribution on the teeth is far more effective than in the parallel shaft type of transmission and the distance between supports is very short.

Electricity Scores Again!

(*Concluded from Page* 46)

pair of light spring fingers and permit the duck to drop. The duck remains in this position until the V-belt upon which the two ducks are carried passes around the driving pulley when it resumes its vertical position by gravity.

As indicated previously, each hit that is scored is registered at the score indicator, and at the end of ten shots (regardless of the score) a limit switch in the duck drive is energized which upon contact of the next duck disconnects the motor circuit.

Timing of the gun light is extremely important for foolproof operation. One of the relays is of the delayed action type, permitting the gun light to remain on for a specific interval after the trigger is pressed; the electric circuit is so arranged that other operations such as the dropping of the ducks and the indicating of the score can take place only during that interval.

In order that some noise will be created when the "bullet" strikes, a thud sounder is installed at the back of the cabinet. This consists of a solenoid which operates at the time the gun is "fired." The back of the cabinet acts as a sounding board and simulates the sound of a shot each time the solenoid operates.

Materials used in the design of the machine are for the most part conventional. Of particular interest, however, is the gun barrel, made from seamless steel tubing, which is parkerized to obviate the effects of dampness and perspiration through constant handling.

loading anti-friction thrust bearings

LAMINUM SHIMS not only provide the precision required for loading this anti-friction bearing in the original assembly . . . the shim makes possible the same accuracy in adjustments from time to time for the life of the bearing . . . without filing or machining! You simply P-E-E-L one or more laminations at a time from the solid laminated brass shim.

Write for a sample of LAMINUM . . . either .002 or .003" laminations.

LAMINUM
Precision adjustment **SHIMS**

LAMINATED SHIM CO., 21-26 44TH AVE., LONG ISLAND CITY, N. Y.

SPRING WASHERS

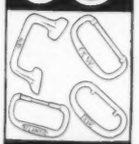
Spring washers and lock washers of every type and size, including the well-known Hipower and Kantlink types. There are thousands of more places where spring washers would improve the value of any product where bolts, nuts, cap or machine screws are used.

STEEL ROD ENDS

Drop forgings including steel rod ends of the adjustable yoke, plain yoke, and eye types. These articles in standard sizes and threads afford tremendous savings over special designs.

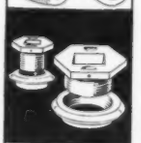
RETAINING RINGS

Spring retaining rings of special heat-treated spring steel are carried in many stock sizes—both open and closed types. Use of a spring retaining ring is an excellent manner of creating a shoulder on a shaft.



CONTAINER HANDLES

Forged steel handles for heavy containers—can be rigidly welded, riveted or attached by a strap to lie flat when not in use. Rugged and most satisfactory for hard usage.



STEEL BARREL CLOSURES

Forged and machined fittings for steel barrels, drums, tanks and metal packages, including plugs, rings and flanges. Very rugged for use in transportation of alcohol, turpentine, oils and other expensive liquids.

RHEOSTATS—RESISTORS—LOAD BOXES AND SPECIAL APPARATUS

Our electrical division—Hardwick, Hindle, Inc.—makes as fine electrical resistance products, fixed and variable, as can be devised.

Other products include windows for buses and railway cars, railway car window curtains, curtain rollers and fixtures, sash locks and lifts.

THE NATIONAL LOCK WASHER COMPANY

NEWARK, N. J.—EXPORT DIV., 15 E. 26 ST., N. Y. C.

IF you are among those who believe cast iron pulleys are as extinct as the dodo bird you ought to look in on the Jones foundry some time. You will see all sizes and types in production for actually the sale of Jones cast iron pulleys is going up all the time.

There are some very good reasons for this activity on Jones cast iron pulleys . . . reasons that you will want to consider in connection with your pulley requirements. They are true running . . . they permit higher speeds . . . no bushings . . . they can't fall apart . . . they don't rattle . . . they look better on most machines . . . they can take a lot of punishment.

It will pay you to get acquainted with the Jones cast iron pulley family — they may help pull you out of a hole sometime or even do you a good turn when you least expect it.

W. A. JONES FOUNDRY & MACHINE CO.

4413 Roosevelt Rd., Chicago, Ill.

BULLETIN No. 66 gives complete engineering specifications and prices on a broad range of Jones cast iron pulleys.

WRITE FOR YOUR COPY

SINGLE ARM SOLID

COMPLETELY SPLIT

DOUBLE ARM

EXTRA HEAVY CONVEYOR

Since 1890

Jones

HERRINGBONE -- WORM — SPUR — GEAR SPEED REDUCERS

CUT AND MOLDED TOOTH GEARS — V-BELT SHEAVES

ANTI-FRICTION PILLOW BLOCKS — PULLEYS

FRICTION CLUTCHES AND TRANSMISSION APPLIANCES

Business and Sales Briefs . . . . . .

ACCORDING to a recent announcement, Bodine Electric Co., Chicago has appointed H. M. Hall, 108 West Sixth street, Los Angeles, as its representative for the southern portion of that state. J. A. Nadon, former representative of the company in that territory, will confine his activities to the northern portion of the state due to increasing business.

* * *

New Departure Mfg. Co., Bristol, Conn., has announced the removal of its Los Angeles office from 1225 South Grand avenue to 2222 South Figueroa street.

* * *

Offices of Norma-Hoffmann Bearings Corp., Stamford, Conn., have been removed from 105 Fahnestock road to 722 Gulf building, Pittsburgh. A. A. Van Pelt continues in charge as manager for the Pittsburgh territory.

* * *

Hannifin Mfg. Co., 621 South Kolmar avenue, Chicago, has purchased the machinery, equipment and name of John F. Allen Co., New York, makers of air-operated riveting machines. Manufacture, sales and service of the riveting machines will be continued as the Allen Riveter Works, division of Hannifin Mfg. Co., at St. Marys, O. The Hannifin company has recently completed its new plant at St. Marys for the production of large machinery.

* * *

Harnischfeger Corp., Milwaukee, has appointed as its sales representative for its line of motors, overhead cranes and hoists, the Lloyd B. Edwards Co., 840 Lumber Exchange building, Minneapolis.

* * *

S. O. Otrich of the former S. O. Otrich company, San Francisco, and A. A. Pederson, formerly sales manager for the United Iron Works, have organized the Transmission Engineering Co. in San Francisco, to serve as a manufacturers' agency. Stearns Magnetic Mfg. Co., Milwaukee, manufacturer of magnetic separators, clutches, brakes and magnetic equipment, is represented by this concern.

* * *

E. W. Smith has resigned as general manager of sales of Pittsburgh Steel Co., Pittsburgh. W. G. Hume continues as manager of sales of wire products and C. V. Lally, manager of sales of seamless steel tubes. J. K. Beeson, formerly assistant general superintendent of the company, is assistant manager of sales. The office of general manager of sales will remain vacant.

* * *

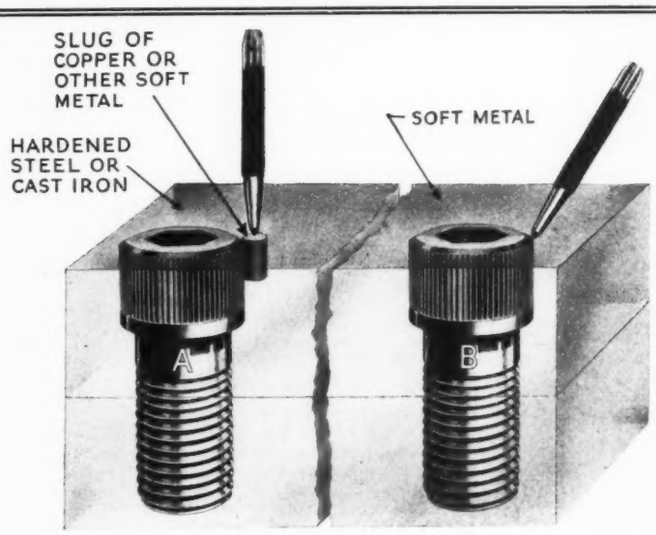
Recent changes in personnel, announced by Driver-Harris Co., Harrison, N. J., are: H. O. Hartdegen, sales engineer, will take charge of the territory comprised of Northern New York state and Eastern Pennsylvania, also handling some accounts in New Jersey, and J. B.

LOCKS *Easily—*

Not only can the "UNBRAKO" be driven faster and farther with the fingers—speeding production—but it can be locked firmly in place by two simple, effective methods.

When the screw is inserted in hardened metal, the soft metal slug (as shown by "A" in the illustration) locks it securely by being spread into the knurls of the screw with the aid of a punch. And in soft metal, illustration "B" shows the easy way of locking.

No other screw has all the advantages of this modern, knurled "UNBRAKO"!

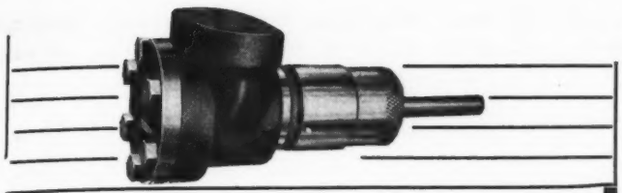


U. S. and Foreign Pat's. Pending

UNBRAKO

KNURLED
Socket Head Cap Screws

STANDARD PRESSED STEEL CO.
JENKINTOWN, PENNA.
BRANCHES: BOSTON, DETROIT, INDIANAPOLIS
BRANCHES: CHICAGO, ST. LOUIS, SAN FRANCISCO
BOX 102



EXPECT MORE
from
VIKING ROTARY PUMPS

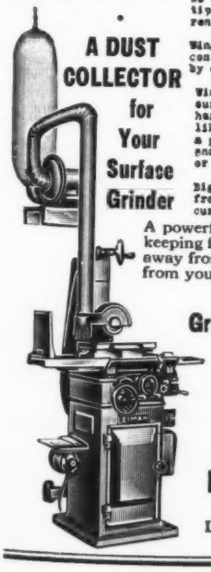
Viking Pumps are not "ordinary" pumps . . . years of trouble-free service in almost every type of industry has proven that. Starting with Viking's Basic Principle, "A Gear Within A Gear", each pump is designed and built for the particular job it is expected to do. Added to this is the "extra premium" of Viking's many years of intensive research. When you install Viking Rotary Pumps, you have the right to expect more, because they have been built to do their job "better". Write for bulletins and price list.

VIKING PUMP CO.
CEDAR FALLS, IOWA

They Take Up Their Own Wear

by the action of centrifugal force.
LEIMAN BROS. PATENTED
Rotary Positive Blowers
and
Vacuum Pumps

Power, Efficient and Noiseless. Use for paper feeding and handling, bottle filling, gas and oil furnaces, agitation and hundreds of other uses.

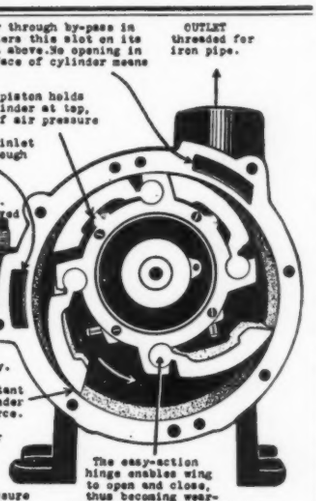


A DUST COLLECTOR for Your Surface Grinder

A powerful apparatus for keeping fine grinding dust away from your work and from your own lungs.

It's a Great Protection Against Lung Dust Diseases

Get the free information.


Air from cylinder through by-pass in cylinder head enters this slot on its way to the outlet above. No opening in curved inner surface of cylinder means quiet operation.
OUTLET threaded for iron pipe.
Enclosed stud in piston holds wing close to cylinder at top, preventing loss of air pressure or vacuum.
Air coming in at inlet at side comes through this slot into cylinder head by-pass and thence into the cylinder. No opening in curved inner surface of cylinder means quiet operation.
INLET threaded for standard iron pipe.
No composition tips to require renewal frequently.
Wing kept in constant contact with cylinder by centrifugal force.
Wing and cylinder surface become hard and glassy-like, insuring a perfect fit and positive pressure or vacuum.
Big air space resulting from small piston and curved wings.
The easy-action hinge enables wing to open and close, thus becoming wear-compensating by the action of centrifugal force.

Machine Design Can Be Greatly Helped

by using air movement instead of mechanical devices. Consult with our experienced engineers about air pumps and their uses

LEIMAN BROS. PATENTED
Rotary Air Pumps

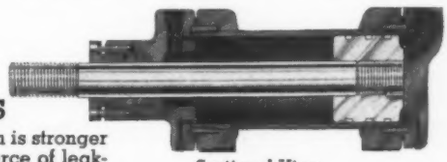
are standard equipment on many automatic machines.

LEIMAN BROS., INC.
177 Christee Street, Newark, N. J.
LEIMAN BROS. New York Corp., 23 Walker St.
Makers of Good Machinery for 50 Years.

Improved

HYDRAULIC CYLINDERS
for Modern Machine Uses

This new type patented Hannifin high-pressure hydraulic cylinder provides every requirement for severe service and high efficiency hydraulic power. Strong, simple construction means ease of application, better appearance, and ready adaptability to a wide variety of uses.



Sectional View

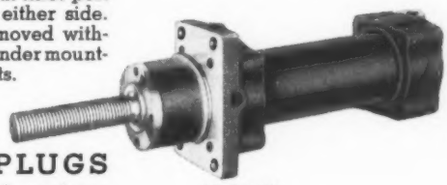
NO TIE RODS

This simplified design is stronger and eliminates a source of leakage. End caps may be removed without collapse of other parts of the assembly.

Model CN

UNIVERSAL CAPS

Either end cap may be positioned, independently, so that inlet port is at top, bottom or either side. Either cap may be moved without disturbing the cylinder mounting or any other parts.



Model JN

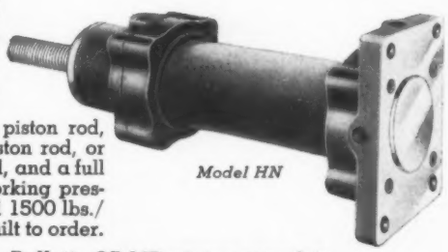
AIR VENT PLUGS

Each end cap has air vents on three sides. With the inlet port at either side or bottom there is always an air vent plug at the top.

Model EN

LEAK-PROOF

Special mirror finish honing produces a cylinder bore straight, round, perfectly smooth, and concentric with the end caps. A perfect piston seal is obtained.



Model HN

MANY TYPES AND SIZES

Hannifin Hydraulic Cylinders are offered in six mounting types, with small diameter piston rod, 2 to 1 differential piston rod, or double end piston rod, and a full range of sizes for working pressures up to 1000 and 1500 lbs./sq. in. Other types built to order.

Write for Bulletin 35-MD giving complete specifications and dimensions.

HANNIFIN MANUFACTURING COMPANY
Engineers • Designers • Manufacturers
Pneumatic and Hydraulic Production Tool Equipment
621-631 SOUTH KOLMAR AVENUE CHICAGO, ILLINOIS

HANNIFIN
HYDRAULIC CYLINDERS

Shelby, formerly in charge of this territory, has been advanced to the management of the foundry division as co-manager with J. Sammon.

* * *

Formerly chemical sales manager of B. F. Goodrich Co. mechanical goods division, Howard E. Fritz has been named manager of Koroseal sales and development.

* * *

Arthur L. George, who had been in the employ of Carnegie-Illinois Steel Corp. and its predecessors since 1895, has retired as manager of sales of the Lorain division of the company. Michael J. Kist, assistant manager of sales, succeeds Mr. George as manager of sales.

* * *

T. S. Long has been made assistant sales manager of the Warren plant of Taylor-Winfield Corp., Warren, O., while W. H. Marion has been named purchasing agent of the home plant and J. D. Anderson, purchasing agent for the Detroit plant.

* * *

P. H. Staerk, who has been connected with Ahlberg Bearing Co., Chicago, since 1920, has become manager of the industrial division in charge of distributor sales, and production sales, of mounted bearings. Mr. Staerk has been specializing in the sale of bearings for power transmission equipment for the past few years.

* * *

Formerly general sales manager, Gulf States Steel Co., Carl C. Brown has been appointed Birmingham district sales manager of Republic Steel Corp.; Robert J. Working has been made assistant district sales manager and W. J. Frawley will continue as sales promotion manager for this district.

* * *

Promotion of D. R. Grandy to the position of assistant sales manager in charge of publicity by the General Electric Vapor Lamp Co., Hoboken, N. J., has recently been announced. Mr. G. J. Taylor succeeds Mr. Grandy as commercial engineer.

* * *

Lincoln Electric Co., Cleveland, has recently announced the following appointments: Don McCormick as arc welding consultant for the Kansas City, Mo., office, at 1818 Main street; William Sivyer and B. B. Ross as sales representatives at the Philadelphia office, 401 North Broad street.

* * *

Harry A. Kraeling, former president of Standard Alloys Co., and formerly president of Standard Steel Propeller Co., has become vice president and general manager of Pittsburgh Gear & Machine Co., Pittsburgh. Henry E. Rea, who has been with the company 17 years, is sales manager and secretary.

* * *

D. J. Henecker, manager of the Buffalo district of Wickwire Spencer Steel Co., New York, since 1934, has been appointed manager of the wire rope sales department, succeeding the late R. H. Cherry. Franklin P. Clark succeeds Mr. Henecker as Buffalo district sales manager.

HIGHER AND HIGHER
GO STANDARDS!
The correct oil film to each individual bearing... automatically
GIDDINGS & LEWIS
Giddings & Lewis boring machine
BIJUR
AUTOMATICALLY Correct LUBRICATION
● Machine design marches on. Higher speeds! Greater precision! AND...SCIENTIFIC LUBRICATION! Hit-or-miss methods will no longer do. Production interruptions must be reduced to a minimum . . . accuracy maintained . . . investment protected. That is why industrial pacemakers specify BIJUR . . . The lubrication system that AUTOMATICALLY provides both a full, centralized control and a continuous oil-feed scientifically regulated for each bearing.
BIJUR LUBRICATING CORPORATION
LONG ISLAND CITY NEW YORK